THURSDAY, OCTOBER 8, 1914.

GERMANY'S AIMS AND AMBITIONS.

LORD ROSEBERY, on March 1, 1893, speaking at the Royal Colonial Institute, said: "We have to remember that it is part of our responsibility and heritage to take care that the world, so far as it can be moulded by us, should receive the Anglo-Saxon, and not another character." If we inquire what is conspicuous in the Anglo-Saxon character, most people will agree, I think, that it is based on regard for our neighbours' rights, a regard which has been the object of our laws and struggles for centuries. The Anglo-Saxon spirit is essentially one which makes for fair-dealing; the race has never been a race of oppressors. Equity, truth, and justice have been our watch-words; and on the whole the nation has acted up to its convictions. It is this national feeling which has led to our taking part in the present war; rather than see a treaty broken, rather than allow a small nation to be coerced into an immoral act by a large and powerful one, we have lent our aid to the French and the Russians, and we are all prepared to support to the death what we all believe to be a righteous cause.

The German view of a nation's duties is very different, and wholly irreconcilable with that of the British and Americans. In the first place, we regard the State as ourselves; we are the State. Representative government leads to this conclusion; if we do not like the policy of our representatives we can change them. But for the German race the State is an external, self-elected body, possessing absolute power over the lives of its subjects. It is for the State to determine what is best; with an army at its back it is useless to attempt to oppose its decisions. The essence of the Teutonic character is to compel everyone to obey what it conceives to be for the good of the community. While the Anglo-Saxon motto may be conceived as "live and let live," the Teutonic command is "live as the State would have you live."

The Anglo-Saxon ideal is the freedom of the individual; the Teutonic ideal the compulsion of the individual by an omnipotent oligarchy.

The effect of the applications of science to practical ends has, during the past century, been the great prosperity of the civilised world. The standard of living has been immensely improved; disease has been diminished, and the average duration of life has been much prolonged. Moreover, the use of machinery has greatly economised energy; the effective production of the race has enormously increased. As a concomitant, the density of the population in European, and indeed in all countries, has also increased, and ever in increasing ratio. It is obvious that such increase cannot go on indefinitely; up to now the accumulation of population has to some extent been modified by emigration; but here, again, there must be a limit. That limit, however, is still a distant one for England; her colonies are still capable of absorbing an enormous population. This is doubtless the reason why British statesmen have practically left unconsidered the economic problem of the increase of population beyond the possibility of feeding it. Moreover, it is not the Anglo-Saxon spirit to prepare to face future difficulties; each difficulty is grappled with when it arises. Not merely is this the character of our race, but our democratic government renders any other course of action practically impossible.

German, or, to be more accurate, Prussian statesmen, have foreseen that difficulties will arise, owing to the natural increase of the German people. Her colonies are relatively unimportant; moreover, they are badly administered, and do not attract settlers. It is true that enormous numbers of Germans have emigrated; it is said that there are no fewer than a million Germans in Brazil; and a very much larger number has found a home in the United States. But these are no longer under German rule; they regard themselves as emancipated, and soon lose connection with, and affection for, their native land. This is naturally repugnant to the Prussian ruling class; and their remedy is war.

The doctrines of humanity are deeply rooted in the Anglo-Saxon spirit; lives are preserved which do not represent a high standard of health and strength; and what may be termed the "virility" of the population decreases. Again, our legislators, though aware of this fact, have taken few steps to face it, if indeed any practical steps are possible. German statesmen, on the other hand, have attempted, by the physical training inseparable from universal military service, to improve the condition of the partially unfit. They imagine that they have secured an advantage over other nations by doing so; and their ideal, with which they have infected practically all Germans, is to secure world supremacy for their race, in the conviction that the condition of humanity will thus be ameliorated. This is the aim which has permeated all classes

of German society during the past generation; this is the cause of the present war. No means are to be neglected to secure this end; righteousness, truth, and justice are to be sacrificed in order that the German race may persist. The German nation has been educated to believe in this ideal by the Prussian ruling caste: "Deutschland über Alles in der Welt." Therefore the war.

Now it may be pointed out that the youth and early manhood of the race are the fighting class; and that by war the most able-bodied of the population are, at least partially, eliminated, with the inevitable result of the deterioration of the race as a whole. Probably it would be argued by Prussian statesmen that the relative number of deaths in war is small; and a successful war will leave abundant healthy men to perpetuate the race. Deterioration by the effects of war, they may contend, is not so wide-spreading as deterioration by the saving of lives of little value.

I have tried to state the case for the German nation; it represents an attempt to aid the elimination of the unfit, the unfit being all who do not hold with German ideals.

Now a race with such an ideal becomes impossible. It cannot be denied that Germany has contributed much in the past to literature, to science, and to the art of music. Individual Germans have attained the highest eminence, and have gained universal admiration. But the originality of the German race has never, in spite of certain brilliant exceptions, been their characteristic; their *métier* has been rather the exploitation of the inventions and discoveries of others; and in this they are conspicuous. The same obedience to command and the same attention to detail may be noticed in their industrial and scientific work as in their army. And of recent years, according to common report, commercial morality among the Germans has been at a low ebb. They are disliked as business men; their methods are not regarded as fair, or their word as trustworthy. Even in the world of science this spirit is by no means unknown. In spite of their boasted progress in what they imagine to be civilisation, they have been relapsing into barbarism. And the execrable deeds of their army—murder of defenceless non-combatants, destruction of priceless buildings, heartless cruelty to women and children—all these are merely the outward and visible sign of their spiritual beliefs. The aim of science is the acquisition of knowledge of the unknown; the aim of applied science, the bettering of the lot of the human race. German ideals are infinitely far removed from the conception of the true man of science; and the methods by which they propose to secure what they regard as the good of humanity are, to all right-thinking men, repugnant. These views are not confined to the Prussian ruling caste, although in it they find active expression: they are the soul of the people.

The conclusion is that this war is a war of humanity against inhumanity; of principle against expediency; of right against wrong. Fortunately, the present aspect of the war is favourable to the Allies; and justice and mercy will undoubtedly triumph.

What is to be justice and mercy? First and foremost, reparation must be made to the Belgians for the outrages which they have suffered; next, France must claim not only damages for the present invasion, but for the indignities of 1871; Russia and Great Britain will no doubt demand compensation. The motto of the Allies must be "Never again." Not merely must the dangerous and insufferable despotism which has eaten like a cancer into the morals of the German nation be annihilated, but all possibility of its resuscitation must be made hopeless. The nation, in the elegant words of one of its distinguished representatives, must be "bled white."

Will the progress of science be thereby retarded? I think not. The greatest advances in scientific thought have not been made by members of the German race; nor have the earlier applications of science had Germany for their origin. So far as we can see at present, the restriction of the Teutons will relieve the world from a deluge of mediocrity. Much of their previous reputation has been due to Hebrews resident among them; and we may safely trust that race to persist in vitality and intellectual activity.

It would be unworthy of the dignity of scientific men to imitate the example of some of the German professors in "abandoning the distinctions conferred on them by English learned societies." It must be remembered that the award of distinctions to Englishmen has been the act of the older race of German men of science, who form the councils of the various academies. Doubtless these men deplore the degradation of their race, as manifested in the outburst of barbarism which has shocked the feelings of the whole world, and it would be a graceful act if English men of science were to retain the marks of their appreciation.

In conclusion, it cannot be contended that the present war has in any sense been promoted by

the imagined spread of education and science in Germany. It affords to all men a lesson, however, that the moral sense of a nation requires educating, as well as the intellect; that a regard for truth, and for the sanctity of a promise are more important possessions than a knowledge of recent discoveries and inventions; and that the intellectual progress of a country is to be measured by the intelligent participation of every citizen in problems of government and of advance in the moral and mental conditions of the race. The splendid response to Lord Kitchener's call to arms shows that, in spite of many small and annoying eddies in the stream of British life and thought, it still flows steadily in the good old channel of probity and honesty.

WILLIAM RAMSAY.

THE GEOGRAPHY OF THE BRITISH EMPIRE.

The Oxford Survey of the British Empire. Edited by Prof. A. J. Herbertson and O. J. R. Howarth.

The British Isles, and Mediterranean Possessions (Gibraltar, Malta, Cyprus). Pp. xii+596+7 maps.

Asia, including the Indian Empire and Dependencies, Ceylon, British Malaya, and Far Eastern Possessions. Pp. x+505+5 maps.

Africa. Pp. xvi+547+5 maps.

America. Pp. x+511+6 maps.

Australasia. Pp. xii+584.

General Survey. Pp. viii+386+1 map. (Oxford: Clarendon Press, 1914.) Price 14*s.* net each.

THOUGH arranged as a series, these volumes can, it would appear, be bought separately. Each volume has the same preface, and the order in the series is distinguished on the back by stars instead of numbers, so as to conceal the oddness of an odd volume. Each volume is by several authors, who have obviously, each as an expert in his own branch, been left a good deal to themselves as to the manner in which their own subjects are to be treated. Each volume is provided with an index, with coloured folding maps showing the physical features, geology, or political divisions of the regions dealt with, with text-maps and diagrams, largely climatological, in black and white, to illustrate the same or other things, and with plates giving illustrations of typical scenery. Each volume, too, has at the end another useful feature, a set of statistical tables, or tables and diagrams relating to the dominions dealt with in the volume, those in the last volume being of a more general and comprehensive character. All the volumes except the last, moreover, have a short gazetteer or alphabetical list of the more important places mentioned in the corresponding volume, with a statement of the situation, and notes as to points of interest. This arrangement will obviously facilitate the bringing up to date of later editions.

The editors are to be congratulated on the success with which the whole work has been carried out. They have obtained the services of a large number of highly competent men, and all those interested in the Empire will feel that they owe them a debt of thanks for the mass of trustworthy information that has here been accumulated, and the instructive statement and discussion of problems connected with the Empire as a whole or its different parts.

In the treatment of each of the larger Dominions there is the same general arrangement of topics, but there is no pedantic adherence to the same grouping of these under chapters. It would have been worse than pedantic to have exactly corresponding chapters in dealing with units so diverse as the British Isles, India, and the Dominion of Canada. In the treatment of the British Isles common sense required that there should be much more detail than could be spared for any other part of the Empire. There are thus five or six chapters under different headings in the section on the British Isles, which occupies, if we include the islands in the British seas, more than five-sixths of the first volume, devoted to the topics which in the section on Canada are treated by Prof. Mavor, of Toronto, in three chapters of remarkable excellence under the general heading "Economic Survey."

We have said that the different authors have evidently been left much to themselves in the treatment of the subjects allotted to them. Inevitably this leads to a certain amount of repetition and overlapping, occasionally to the expression of divergent views. Thus it is natural to find Mr. R. D. Oldham, who deals with the physical geography of India, and Mr. J. S. Cotton, editor of the "Imperial Gazetteer of India," who handles Indian agriculture, both take up the subject of Indian soils, and it is distinctly instructive to find that the man of letters is quite confident as to the origin of those soils, while the geologist is not. On matters of more importance such discrepancies are not at all to be regretted. They keep the student in mind of the fact that there are multitudes of questions on which competent authorities trained to inquire into truth for its own sake hold different opinions. Even where there is no actual conflict of opinion it is useful to have different shades of view expressed. Those,

for example, who read in the Africa volume Mr. Basil Worsfold's interesting and valuable statement of native problems in South Africa will be able to read them in the light of the observations made by Mr. E. B. Sargant in the chapter on educational problems of the Empire, culminating in the reflection that where there are two distinct social orders, of which one represents largely the hewers of wood and drawers of water, "any neglect of the development of the more backward group must react unfavourably upon the development of the other, and ultimately leave its mark upon the whole Empire" (General Survey, p. 233), as, on the other hand, those who read these highly general observations will have the advantage of considering them in the light of the more concrete presentments of fact elsewhere.

While there is so much to be thankful for in these volumes there are nevertheless one or two things to regret. To begin with a minor matter, it may be pointed out that some of the maps and diagrams are not so completely self-explanatory as one would like them to be. Thus, in the map of the "Economic Regions of Canada" in the America volume, it is not clear what territory the so-called "Central Agricultural Region" is intended to include. In the map of the "Railways of Eastern Canada," p. 189, there seems to be some mistake in the reference. In the very interesting rainfall diagram on p. 334, as on that of the monthly discharge of the Nile on p. 345, it would be well to add at least the latitudes of the places mentioned. In the former, for example, the contrast between Wadelai and Ghaba Shambe would be all the more striking if we knew that there there is only 4° of latitude between the two places, a fact which there is no means of finding out from the book, inasmuch as Ghaba Shambe is not named on the map of north-east Africa, between pp. 316 and 377.

Then, further, it is both surprising and regrettable that in a work coming out virtually under the auspices of the Oxford School of Geography there should have been apparently so little systematic endeavour to give prominence to geographical influences. Even in the section on the British Isles, a good deal more space is given to the administration of towns than to the conditions that tend to fix their sites and promote their growth. In the Australasia volume there is indeed a deliberate effort to develop those influences in the chapter on physical geography, but this attempt, to our mind, suffers somewhat from the prominence given to geological history in setting forth those influences. The sentences in this chapter may in many cases be individually interesting, but the reading of a paragraph, notwithstanding the illustration by block diagrams, is often hard, that of a sequence of paragraphs still more so.

But there is one chapter conspicuously free from this fault, a chapter by an unnamed writer in which what may be called the geography of British policy and of British strategy is expounded in such illuminating fashion that the most ignorant under this head will be enlightened, a chapter which will be read in present circumstances with the keenest interest, and for the sake of which alone it would be worth while for anyone who has fourteen shillings to spare to buy the volume—that containing the general survey, an admirable volume in other respects. We may conclude this review with a quotation from the chapter (p. 190), which all of us may ponder with profit at the present time:—

"The geographical situation of the British Isles confers certain advantages from the point of view of waging offensive warfare. It greatly facilitates the protection of our oversea trade against an enemy that is compelled to issue from the North Sea to gain access to the Atlantic, and it enables us to keep the ports on the other side of the Channel under effective observation should necessity to do so arise. But against those advantages must be weighed those conferred by a possible enemy for waging warfare by the double exit from the Baltic *viâ* the Kiel Canal and the Skaggerak. This double exit not only increases the difficulty of maintaining effective observation on any hostile fleet that can make use of either passage, but imposes upon us the necessity of keeping our main fleet in a position from which it can ensure bringing the enemy to action before he can break out of the North Sea, and in certain circumstances might prevent any division of the battle fleet." G. G. C.

POPULAR NATURAL HISTORY.

(1) *The Courtship of Animals.* By W. P. Pycraft. Pp. xvi+318+40 plates. (London: Hutchinson and Co., 1913.) Price 6*s.* net.

(2) *Hunting the Elephant in Africa and other Recollections of Thirteen Years' Wanderings.* By Captain C. H. Stigand. With an Introduction by Colonel Theodore Roosevelt. Pp. xv+379+plates. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 10*s.* 6*d.* net.

(3) *Gardens of the Great Mughals.* By C. M. Villiers Stuart. Pp. xviii + 290 + plates. (London: A. and C. Black, 1913.) Price 12*s.* 6*d.* net.

(4) *Ce que j'ai vu chez les bêtes.* By Paul Noël. Preface de G. Colomb. Pp. 343. (Paris: Librairie Armand Colin, 1913.) Price 3.50 francs.

(5) *Cassell's Natural History.* By F. Martin Duncan. Pp. xx+432+plates. (London: Cassell and Co., Ltd., 1913.) Price 9*s.* net.

(6) *Animals of the Past: An Account of Some of the Creatures of the Ancient World.* By F. A. Lucas. Pp. xx+266+plates. (New York: American Museum of Natural History, 1913.)

(7) *Butterflies and Moths in Romance and Reality.* By W. F. Kirby. Pp. 178+28 plates. (London: S.P.C.K., 1913.) Price 5*s.* net.

(8) *Common British Moths.* By A. M. Stewart. Pp. viii+88+15 plates. (London: A. and C. Black, 1913.) Price 1*s.* 6*d.* net.

(1) MR. PYCRAFT has written a very interesting comparative study of the love-making of a great range of animals selected from most of the main zoological groups. The explanation given by Darwin as to the origin of the secondary sexual characters is now, he answers, rather out of date, and Wallace's "arguments for sexual selection are far from convincing and often inconsistent." The "theme" of the book is to show that a sharp line must be drawn between those attributes which are necessary to achieve individual survival and those to achieve the survival of the race-factors which, in the latter, are embraced under sexual selection. Much, Mr. Pycraft believes, hitherto attributed to the action of sexual selection alone—such as the behaviour of animals during sexual activity and the colours they display at this season—is largely governed by the action of "hormones" (the secretions of various ductless glands in the body). "Suggestion" is also necessary, but "suggestion does not suggest" till the hormones have rendered the system inflammable; "suggestion by display" of some kind, as an aphrodisiac, is a necessity, or "how else can desire be indicated? Here is sexual selection." The limits of space assigned to us forbid our discussing this question—which is very interesting, but perhaps less entirely novel than the author realises—beyond mildly "suggesting" that Mr. Pycraft's system seems so saturated by one or more hormones as to "exalt" his particular point of view somewhat at the expense of others. We heartily recommend the book, nevertheless. It contains eighty illustrations on art paper.

(2) Captain Stigand is a well-known African official, devoted to hunting, who always provides his readers with an entertaining, well-written story. The unending stream of books on big-game hunting has, however, now made us fairly intimately acquainted with the lives and artifices of both the hunter and the hunted, so that from this point of view the author's elephant-hunting episodes are less interesting to the general student of nature than the discussion we have in his book upon protective coloration applied to big game. Mr. Roosevelt, in a foreword to the volume, avers, in his usual strenuous language, that the extreme theories of Poulton and Thayer "on this subject" have no bases whatever "in fact," and Mr. Wallace has "strained the recognition-mark theory to an impossible point," but that Captain Stigand's observations now leave "no excuse for further mistakes in the matter." But for the editorial fiat as to space, we are of opinion that it might still be shown that "all is not yet up" with the earlier theories. We can only refer those interested in the subject to the book, to wrestle out the matter for themselves.

(3) Mrs. C. Villiers Stuart's pages form charming memorials of the wonderful old, beflowered, and be-avenued gardens of the Indian emperors, with their warbling fountains and their running waters, so delicious to eye and ear in a parched land. She describes them not only in choice and delicate language, but depicts them in water-colours of great beauty and charm. One of the author's objects, apparently, in writing this book has been to give expression to the hope that in the New Delhi similar gardens may be reproduced. This is a delightful vision; but we greatly fear that the romance that haloes the Mughals and the beauties of their harems, of whom these walled pleasaunces were the shady ambulatory, cannot be revived in our days, and be the gardens of New Delhi never so gay and be-fountained, they will never reproduce those delightful enclosures as they appear to us through the sunlit haze of four hundred years.

(4) We have found the little book by M. Paul Noël, director of the Laboratory of Agricultural Entomology of the Seine-Inférieure, with the quaint title of "Ce que j'ai vu chez les bêtes," very delightful reading. It is written in the very simple, elegant, but exact language for which French scientific writers are so distinguished, and deals with a large number of the common insects, birds, reptiles, and mammals of the country. The author describes and figures several very admirable automatic appliances—for catching insects, rearing larvæ, and other purposes—invented by him in the course of his experiments and observations. Had it not a better use, it would form a very excellent French primer for young nature students.

(5) Mr. F. Duncan's book may be called a digest of the several volumes of the well-known "Cassell's Natural History," by the late Dr. P. Martin Duncan, although to attempt to deal adequately with the whole animal kingdom, as is done here, in a comparatively small volume, is,

we think, an over-bold adventure. The space allotted to many of the phyla is disproportionate to their importance. It is somewhat difficult to form an opinion of the class of reader for whom this book is intended, for we think that neither the general reader interested in natural history, nor the serious zoologist in need of a book of reference, will find it very satisfactory. The volume is well illustrated by 200 photographic reproductions.

(6) Mr. Lucas, the director of the American Museum of Natural History in New York, gives in this volume an account of a number of the most striking prehistoric animals on view in that institution, to the library of handbooks of which it forms a valuable addition. The author's name is sufficient guarantee for the accuracy of its contents; and Mr. Knight's—an artist well known for his skill in depicting prehistoric animals—for the restorations provided in it. Biographical references are appended to each chapter, and there is a sufficient index.

(7) This is a posthumous volume by Mr. W. F. Kirby, well known by his entomological work. As a general account of the lepidoptera the volume will be found accurate, and written in a more than usually interesting style. It is well illustrated by twenty-eight very excellent coloured plates, "made in Germany."

The last volume (8) on our list, one of the "Peeps at Nature" series, dealing only with our common British moths, is more sketchy than Mr. Kirby's. The colour photographs with which it is illustrated are, however, specially good.

ELECTRICAL ENGINEERING.

(1) *Telegraphy*. By the late Sir W. H. Preece and Sir J. Sivewright. Revised and partly rewritten by W. L. Preece. Pp. x+422. (London: Longmans, Green and Co., 1914.) Price 7*s*. 6*d*. net.

(2) *Continuous and Alternating Current Machinery*. An Elementary Text-book for use in Technical Schools. By Prof. J. H. Morecroft. Pp. ix+466. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 7*s*. 6*d*. net.

(3) *Laboratory Manual, Direct and Alternating Current*. Prepared to accompany Timbie's "Elements of Electricity." By C. E. Clewell. Pp. vii+100. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 4*s*. 6*d*. net.

(4) *Transmission Line Formulas for Electrical Engineers and Engineering Students*. By H. B. Dwight. Pp. vi+137. (London: Constable and Co., Ltd., 1913.) Price 8*s*. 6*d*. net.

(5) *Wireless Telegraphy*. A Handbook for the Use of Operators and Students. By W. H. Marchant. Pp. xi+241. (London: Whittaker and Co., 1914.) Price 5*s*. net.

(6) *Incandescent Electric Lamps and Their Application*. By Daniel H. Ogley. Pp. x+107. (London: Longmans, Green and Co., 1914.) Price 2*s*. 6*d*. net.

(1) A BOOK based on the immense experience of the late Sir Wm. Preece could scarcely fail to be of the greatest value to telegraphists at large; when, in addition, it has passed through edition after edition for nearly forty years, it is almost superfluous for a reviewer to give either praise or blame. The present edition has been again revised and brought up to date; it has been recast into a larger size of page, which we consider an improvement.

For those who are now beginning their subject we would say that the work aims at describing the simpler methods of land telegraphy, and includes the principles of duplex, quadruplex, and multiplex working, besides the elements of telephone exchange system. There are thoroughly practical chapters on materials and outdoor construction, besides information as to faults and tests. With scarcely an exception, the descriptions are lucid and clear; the literary style is pleasing, padding is absent, and practice lives on every page.

Submarine telegraphy is not included, being regarded as beyond the range of the book. We think it would have been well if wireless had been treated in the same way, as the chapter on this subject (the last one) does not give the reader the same grasp of essentials that the remainder of the book does.

(2) After a careful study of this excellent text-book, any intelligent engineer or engineering student ought to have a good general knowledge of the various kinds of electrical machinery now in use. Although the treatment is of an elementary kind and includes very few formulas, it is very thorough. It discusses all the essential actions in the more important machines very clearly, and includes many useful points which are seldom to be found in text-books. It is somewhat unfortunate that in the preliminary discussions given in the first few chapters the author has chosen entirely to ignore certain facts, and so gives the student a false impression, which he has to correct when the full discussion is reached later on. Thus, the reader to whom the matter is new would probably gather from p. 20 that magnetic hysteresis is the only source of loss in

an armature core; from p. 81 that the correct position for the brushes never depends on the load; and from p. 85 that the heating of a continuous-current armature is the only thing which limits its output.

The book is well illustrated, both by diagrams and half-tone blocks. The latter have mostly been derived from the literature of the large American manufacturing companies, but they have been well chosen; in a few cases only, mostly of instruments, do they show too little detail for the purpose in view. The British reader must, of course, remember that the book is American, and that the statements as to standards and regulations do not necessarily apply to this country.

(3) This book appears to be specially written for use in the author's own laboratory, and we scarcely think it will be of much service elsewhere. It deals with twenty experiments on continuous-current machines and apparatus, and ten on alternating-current ones. It can scarcely be said to describe them, and it certainly does not give those useful practical hints which every laboratory instructor knows to be necessary to enable even the best students to carry out their work successfully. The student is referred to another book for practically everything in the way of information; as we have not seen that book, perhaps it would not be quite fair to criticise this one in detail. But we must confess that except in special circumstances we should never think of using 110-volt mains for measuring the resistance of a yard or two of wire or of the armature of a dynamo, nor of complicating matters by the addition of a short-circuiting switch for every ammeter. On the other hand, we should certainly specify the use of fuses to guard against accident, although the author omits them from his diagrams and instructions.

(4) This excellent little book is a collection of formulas for calculating the voltages and currents at any point in a power transmission line the loads and constants of which are known. It is more a reference book for engineers who have to make such calculations than a text-book for students, but to those of the latter who wish to get up this particular work we can highly commend it. Following an ingenious chart from which the desired results can be read off with sufficient accuracy in the case of short lines, we are given, in tabular form, sets of formulas of increasing degree of accuracy to suit the chief cases which arise. The limits of application are carefully indicated in each case.

Part ii. gives an account of the theory on which these formulas are based; this portion is a model of conciseness combined with lucidity. Part iii. is a repetition of the tables of formulas, with the addition of tables of constants of copper and aluminium cables for the American standard frequencies of 25 and 60 cycles per sec.

(5) This book is non-mathematical and can be thoroughly recommended to those for whom it was written. It gives a very good account of the Marconi system, and also of the various other ones about which the public have lately heard so much. With few exceptions, the descriptions are good and the illustrations are excellent. We should have liked a rather better elementary account of the production of oscillations and of the emission of waves from the oscillator, and also a more convincing explanation of the action of the Marconi magnetic detector. Nor can we imagine any reason for the peculiar connections given on p. 50 for a shunt-wound motor starter.

(6) We wish we could compel all architects, wiring contractors, shopkeepers, and users of electric light generally to read this little book. We might then have fewer glaring (in more ways than one) examples of how not to arrange artificial illumination. The book contains little about the construction of the lamps, but gives an excellent account of their characteristics and of the principles which must be followed if a pleasing result is to be obtained from their use.

DAVID ROBERTSON.

CELESTIAL MECHANICS.

An Introduction to Celestial Mechanics. Second revised edition. By Prof. F. R. Moulton. Pp. xvi+437. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 15*s.* net.

THE appearance of Prof. Moulton's introductory treatise on dynamical astronomy in a second edition is a sufficient proof that the work, which was first published twelve years ago, has satisfied a certain demand. This is very natural, for there is no similar book which covers the same ground. After the revision which it has now undergone it should prove even more useful than in its original form. The author's aim has been to give the student that general view of the whole subject, so far as it can be treated by fairly elementary methods, from which he may pass on, if he pleases to go further, to the technical details which are to be found in treatises on "Bahnbestimmung," or to the refined mathematical processes which are developed in theoretical works on celestial mechanics, or in the original memoirs of the great masters.

The early chapters develop the problem of two bodies in undisturbed motion. They lead up

naturally to the problem of determining orbits, which has received a new and admirably clear treatment, and is now placed in its logical order as an illustration of the application of the preceding theory. Even so, the fourth chapter, which deals with attractions, seems to some extent out of place, as it interrupts the study of those parts of the subject which depend essentially on particle dynamics. An interesting chapter on the problem of three bodies leads up to the final section of the book, in which the subject of perturbations is discussed both geometrically and analytically. These two methods will scarcely appeal with equal force to the same class of student.

The book is probably better adapted to the requirements of the American than of the English student. In this country it would be assumed that a reader who was capable of really profiting by the last chapter, for example, must have a considerable mathematical equipment. One would therefore expect a more thorough treatment of some points for which room might be found by omitting some of the more elementary explanations. In America, on the other hand, there is more chance of appealing to some immature but keen student who will be induced to pursue his studies further.

Numerous examples are given, and an index. An excellent feature is to be remarked in the historical and bibliographical notes. With the dictum that Galileo was a man of greater genius than Kepler we are tempted to disagree profoundly; but when genius runs in such distinct moulds, who is to decide? H. C. P.

OUR BOOKSHELF.

The Practice of Navigation and Nautical Astronomy. By Lieut. H. Raper. Twentieth edition. Pp. xxv+934. (London: J. D. Potter, 1914.) n.p.

It is possible to keep the most valuable educational treatise too long before the public; methods grow obsolete with lapse of time and in altered conditions, but later editors, fettered by the spell of tradition, fail to use the pruning knife with sufficient freedom. As a pioneer instructor, seventy-five years ago, Raper's work was admirable. He raised the standard of accuracy, he appreciated the necessity of systematising processes, of shortening calculations, and of ensuring correctness in working. Others occupying the more advanced outposts that he made tenable have improved on his methods, benefited by wider experience, and have aimed at greater efficiency. Of course there is nothing wrong in Raper's book; too many critical eyes have examined its principles, and too many practical hands have tested its usefulness. But accuracy of statement is not all we look for in modern treatises. We expect to find placed at the service of the student all that has been achieved by science, analytical or practical.

Tested by such criteria, the treatise that guided admirably the navigators before the age of steam or of iron and steel built vessels is a little disappointing. In a modern book one would scarcely expect the explanation of Sumner's method of finding a ship's position at sea tucked away in an appendix or limited to a few paragraphs in the text. So far as we can see the student would not suspect that the time-honoured noon sight for latitude, and the morning or afternoon sight for longitude, are but special cases of this most powerful method. The theory of the Sumner Lines of position is so easy to understand, and at the same time is so widely applicable, that it should be made the basis upon which the whole theory of practical navigation depends. Again there is no mention of the desirability of observing time signals sent out by wireless telegraphy, and of the opportunities thus afforded for obtaining accurate Greenwich time. The practical methods suggested by Darwin for deriving improved tidal tables receive but the scantiest mention. These may be slight defects, but we think they indicate the inadvisability of attempting to accommodate an excellent book in its day to the requirements of another generation, possessing enlarged facilities and seeking more scientific instruction.

W. E. P.

Memorabilia Mathematica, or the Philomath's Quotation Book. By Prof. R. E. Moritz. Pp. vii+410. (New York: The Macmillan Co., 1914.) Price 12*s.* 6*d.* net.

Prof. Moritz has brought together more than two thousand passages from the writings of mathematicians, philosophers, and others, and has grouped them under twenty heads, as well as indexed them under nearly seven hundred topics. Among the subjects of the groups of passages which make up the chapters of the book are:—the object, nature, value, and teaching of mathematics; study and research; persons and anecdotes; logic, philosophy, and science in relation to mathematics; arithmetic; algebra; geometry; the calculus and allied topics; concepts of time and space; paradoxes and curiosities. All the passages are in English, having been translated when the original extracts were in other languages. Full references are given, so that the originals can be consulted by the inquiring student when desired.

The preparation of such an extensive collection of notable utterances of some of the world's greatest thinkers must have involved enormous labour; and many writers and teachers will be grateful to the author for providing them with this anthology of mathematical philosophy. The extracts are of varying length and merit, but they are all interesting, and the grouping, as well as the index, enable selections upon particular aspects of mathe-

matical thought and work to be found easily. Passages 907 and 1643, which are given in German from Schiller and Jacobi, as well as in English, appear to be repetitions of the same story in slightly different renderings.

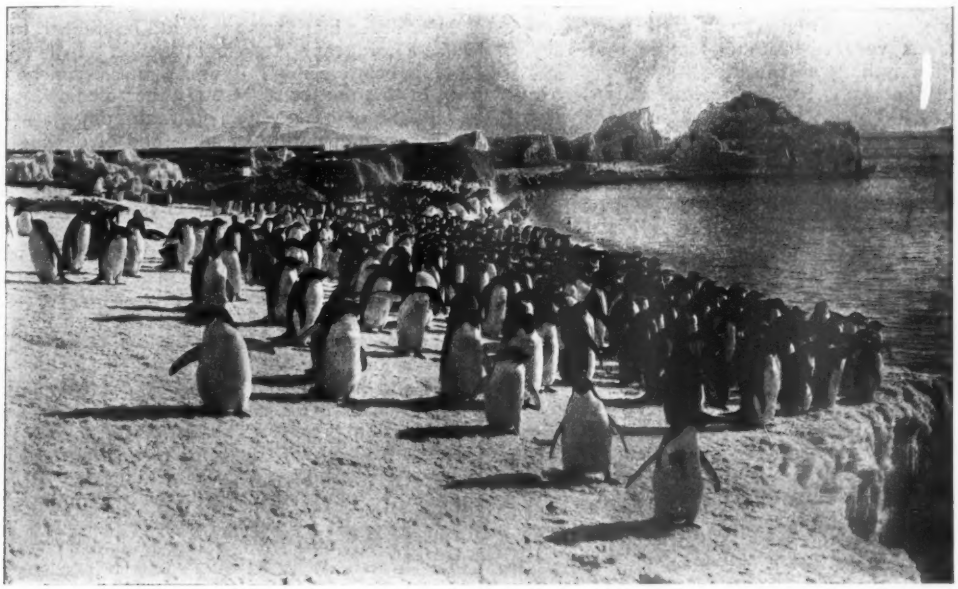
Zur Lehre von den Zuständen der Materie. By Prof. P. P. von Weimarn. Band I.: Text. Pp. x+190. Band II.: Atlas. Tafeln lii. 2 Vols. (Dresden and Leipzig: T. Steinkopff, 1914.) Price 7 marks.

THESE two volumes are put forward in proof of the author's main thesis "that colloid-amorphous properties appear in bodies as their comminution increases, and that such comminution is possible in all bodies." The well-executed atlas of plates reproduces photographs of crystallisation processes in various concentrations, chiefly of barium sulphate and aluminium hydroxide. It is shown that the size of the crystals is strongly influenced either way by the concentration. Examined in the ultra-microscope, jellies and transparent colloid structures generally show minute particles which are essentially crystalline, differing from crystals only in their size. Any solid, sufficiently comminuted, might be made into a "solid mist" of particles showing Brownian motions, but the latter are just what leads as a rule to crystalline agglomeration. By comminuting aniline-blue into a neutral substance (urea), Pihlblad obtained colloid solutions of the former in water of any degree of fineness. The author, in view of these facts, proposes to substitute the term "dispersoid" for the less significant term "colloid," and would call the science of colloids "dispersoidology."

PROBLEMS OF THE PENGUINERY.[1]

DR. LEVICK has made a fascinating study of the Adélie penguins (*Pygoscelis adeliae*), and the charm of his book is enhanced by his beautiful and really interesting photographs. He has certainly a good subject, for penguins are among the quaintest of living creatures, among the most ancient of birds, triumphs of adaptation to aquatic life, remarkably congruent with Antarctic conditions, and very instructive from a psychological and even sociological point of view. Inquisitive, unafraid, altruistic and social, they make a strong claim on our interest and sympathy.

The Adélie penguins spend their summer and bring forth their young in the far South. They



"Occasionally an unaccountable 'broodiness' seemed to take possession of the Penguins." From "Antarctic Penguins."

seek out wind-swept places, kept bare of snow, where they find solid ground and pebbles for making nests. After the chicks have been sufficiently educated to be able to fend for themselves, young and old leave the southern limits of the sea and make their way to the pack-ice out to the northward. The first year's birds remain on the pack for two winters, until they get their adult plumage. "The spring following this, and probably every spring for the rest of their lives, they return south to breed, performing their journey, very often, not only by water, but on foot across many miles of frozen sea." That they find the breeding ground is remarkable, for they cannot see far when they are swimming (and there is often nothing to be seen), or when they are "tobogganing," and their horizon when walking

[1] "Antarctic Penguins." By Dr. G. Murray Levick. Pp. x+140+ plates. (London: W. Heinemann, 1914.) Price 6s. net.

is only one mile distant. Dr. Levick believes that they have a special sense of direction.

At Cape Adare the penguins returned from the sea about the middle of October; they were at first fatigued and sleepy but soon began to pair and nest. Dr. Levick describes the combats of the cocks, who strike one another doughtily (with one flipper at a time, but ambidextrously); the gentleness and patience of the combatants in their overtures to their desired mates, who make some show of reluctance and have a tendency to hen-peck; the ecstatic attitude assumed at times by either sex, with an associated *chant de satisfaction* which seems to arouse the other partner to come to soothe the first; the activity of the cocks in gathering stones for the nest, often stealing them (a preference for bright colours was noticed); and the individual differences in character, for there are vigilant and unwary, tough and timorous birds. A very remarkable fact is that they do not eat anything all the time!

The fast may be prolonged for twenty-seven days of strenuous life. Thirst is quenched with snow, and on rare occasions the cock may bring a lump to the nesting hen. Incubation seems to last for rather more than a month, the female taking the first fortnight while the male goes off to recuperate; towards the end of the period the parent birds go to the sea in turn, feeding greedily on the abundant Euphausid crustaceans. The developing eggs have to be protected from the cold and from the intrusive skuas. "Evidence goes to show that the sea-leopard is the only living enemy, excepting man, that threatens the life of the adult Adélie penguin." Dr. Levick gives a delightful account of the habits of the penguins in the water and of their games. But there are two points of even greater interest. As the chicks become bigger and their appetites likewise, the turn-about method of securing food is inadequate. "The individual care of the chicks by their parents is abandoned, and in place of this colonies start to 'pool' their offspring, which are herded together into clumps or *crèches*, each of which is guarded by a few old birds, the rest being free to go and forage." The guardians of the *crèche* protect the chicks from the skuas and from the not less troublesome "hooligan" cocks (apparently idle bachelors and wicked widowers). Also suggestive of social development was an extraordinary occurrence witnessed by Dr. Levick and Mr. Priestley, a congregating of penguins into massed bands some thousands strong and an apparent drilling! From one of the motionless bands a single bird ran out in the direction of another band, and stopped. In a flash the entire band from which he came executed the movement "left turn." The band which he had approached did the same, and the two bands marched straight towards one another, and joined to form one body. Similar procedure continued for many hours. Dr. Levick's suggestion is that the "drilling" is a reminiscence of "massing" before migration, going back perhaps to flying days! We have to congratulate the author on his well-told story.

THE PROTECTIVE TREATMENT AGAINST TYPHOID FEVER.

TYPHOID fever is inseparable from war. It finds in war, ready for it, all that it could desire. In times of peace we have a thousand ways of avoiding it, a thousand ways of holding it up: so sure are our defences, so elaborate our plans, that we get into a stupid way of thinking of typhoid fever as if it were due only to "insanitary surroundings"; as if it were a disease altogether unlikely to show itself within ten miles of a good medical health officer. Then comes war; and, with declaration of war, comes the general mobilisation of the infective diseases. They are called up, they are sent to the front. Louvain as it was and Louvain as it is are scarcely more unlike than are typhoid in times of peace and typhoid in time of war.

For sheer inaccuracy it would be difficult to surpass a paragraph lately published in a little journal which bears a medical name, but certainly does not in this matter represent either medical opinion or public opinion. This journal "objects *in toto* to serum inoculation as a method of dealing with typhoid." We can measure the wisdom of the little journal, here, by the fact that the protective treatment against typhoid is not a serum-treatment, and has nothing to do with any sort or kind of serum. Then the journal says: "In the parts of France where our troops are operating there should be no difficulty with regard to hygiene. The troops are not shut up in a city closely invested and living on famine rations, but are constantly on the move in a land flowing 'with milk and honey,' not to mention rivers of grape juice, which is, if rationally used, Nature's own 'anti-typhoid serum.'" It says that; it really does. And one of the "anti-vivisection" societies has published an advertisement saying that the protective treatment "leads to tuberculosis"!

Typhoid is, of course, already taking part in the present war. Given the Allied Armies and the German Army in the Western Theatre, how should there not be typhoid? The only question is, How much more will there be a month hence? The lateness of the year, happily, will kill off flies, which are great carriers of the disease; but the flies are not yet gone, and they will more or less repeat that deadly part which they took in the South African War. There is plenty of the disease for them to carry. "It is well known," says Sir Almroth Wright, in the *Times*, September 28, "that the infection of typhoid is thickly sown all along the frontier of France and Germany." Besides, among two millions of men, there are bound to be some who have the germs of the disease in them. And what is the good of talking of "sanitation," as if our men could have the warm baths and the water-closets of the average Englishman's home? Let us take Dr. Johnson's advice, and clear our minds of cant. "An army," as Wright says, "on going out on active service goes from the sanitary conditions of civilisation straight back to those of barbarism. . . . In war the doors are everywhere opened

wide, both to the direct conveyance of infection by the excreta, and to its indirect conveyance by means of contaminated water. . . . On service, proper sanitary arrangements are very often impossible. We may think, for instance, of the situation of men in the trenches under fire. . . . When it comes to a tight place the alternative which will present itself will be that of drinking a polluted water or none. . . . It will, by the very nature of the case, be out of question to apply ordinary sanitary measures in an effective manner. . . . Infection spreads not only among the troops in the field, but also among the soldiers in hospital."

The *Daily Chronicle*, October 3, says, "It is reported that 800 Germans, on the lines between Brussels and Antwerp, are suffering from typhoid fever."

That the protective treatment is indeed protective we all know. It is the experience of the nations of the earth; and the whole world is agreed about it. France, India, Canada, the United States, Italy—let alone our enemies—are of one mind. Take only four instances:—

1. *British Army in India.*—"The histories, as regards typhoid fever, of 19,314 soldiers, whose average period of service abroad was twenty months, were carefully followed, and every precaution possible was taken to verify the diagnosis bacteriologically. Of this number 10,378 were inoculated, and 8936 not inoculated. The case incidence of typhoid fever among the inoculated was 5·39 per 1000, and among the non-inoculated 30·4 per 1000."—*Report of Anti-Typhoid Committee*, 1912.

2. *United States Army.*—"Inoculation was made compulsory in the American Army in 1911, and has practically abolished the disease. In 1913 there were only three cases and no deaths in the entire army of over 90,000 men."—Sir W. Leishman, *Brit. Med. Journ.*, August 22, 1914.

3. *French Army.*—In 1912 typhoid broke out in the barracks at Avignon. Of 2053 men, 1366 were protected and 687 were not. The non-protected had 155 cases, with twenty-one deaths; the protected had not one case. The protective treatment was made compulsory last winter in the French Army; and, in special circumstances, among the reservists.—*Lancet*, January 4, 1913.

4. *Canadian-Pacific Railway.*—Throughout the "railway camps" in Alberta, during 1911, among 5500 protected there were only two cases of typhoid; among 4500 non-protected there were 220 cases.—*Brit. Med. Journ.*, June 6, 1914.

It remains to be noted: (1) That the vaccine contains no living germs of any sort. (2) That the treatment, though it gave good results in the South African War, has been improved since that time. (3) That the avoidance of exertion and excitement, on the day of treatment, is a great safeguard against any disturbance of the general health. (4) That, when time allows, it is always best to give the vaccine not all in one dose, but in two, or even three graduated doses, with a few days between each dose.

Sir Almroth Wright, by whose hands the gift of this treatment came to us, greatly desires that the treatment should be made compulsory, as in other armies, so in ours. Surely it is part of "my duty to my neighbour" that I should not, by having typhoid, expose him to the risk of infection from me. And it is certain that a soldier down with typhoid fever is not only useless against the enemy, but dangerous to his own friends.

STEPHEN PAGET.

THE BRITISH ASSOCIATION IN VICTORIA.

MELBOURNE, AUGUST 20.

ON their arrival from Adelaide by three special trains on Thursday, August 13, the visitors were taken to their quarters, but soon most of them found their way to the reception room at the University. The lecture theatres of the University, and of the Teachers Training College, afforded ample accommodation for all the sections, and are in the same grounds.

In the evening the Governor-General received members at Government House, and some 3000 guests were present at a brilliant function. On Friday afternoon, August 14, a graduation ceremony was held in Melba Hall, when nearly 1000 persons were present. The degree of D.Sc. was conferred on the president, Prof. W. Bateson, and on Sir Edward Schäfer, Prof. H. E. Armstrong, Dr. F. W. Dyson, Sir Thomas Holland, Prof. W. J. Pope, Prof. A. W. Porter, Sir Ernest Rutherford, Prof. Johannes Walther, Prof. W. M. Davies, Prof. C. G. Abbott, and Prof. Luigi Luiggi. At a later hour the Lord Mayor held a reception at the Town Hall, which was largely attended. In the evening the president delivered the first half of his address in the auditorium in the presence of more than 2000 persons. The Governor-General and the State Governor were present, and proposed and seconded the vote of thanks.

On Monday afternoon, August 17, Prof. E. B. Poulton delivered a discourse on "Mimicry" before a very large and appreciative audience. In the evening the Government of Victoria held a reception at the Public Library, Picture Gallery, and National Museum, the buildings for which are in communication. The guests, numbering about 4000, were received by the Premier, Sir Alexander Peacock, Lady Peacock, and by the Chief Secretary, the Hon. John Murray. The ample accommodation afforded by the large rooms prevented undue crowding, and the evening was most enjoyable.

On the following afternoon the Overseas members were entertained at the Botanic Gardens by the members of the scientific societies of Victoria. The weather was delightful, and the magnificent gardens were greatly admired by the guests. The president planted a memorial tree (*Cupressus macrocarpus*) to commemorate the historic visit of the association. In the evening

Dr. F. W. Dyson delivered the second discourse on "Greenwich Observatory and its Work."

A number of week-end excursions were made, and, owing largely to the beautiful, though unseasonable, weather, were all successful. The greater number of the excursionists were Overseas members, the Australian members being restricted largely to the official leaders and experts in what may be called "side-issues." Thus, a geological excursion would be accompanied by someone who could name plants, and so on.

About forty went by special train to Bacchus Marsh to inspect the Permo-Carboniferous glacials. Drs. Hall and Pritchard were the leaders, and Messrs. Sweet and Brittlebank, who discovered and worked out the beds, were present to help, and the main features were clearly seen.

The Surveyor-General, Mr. J. M. Reed, led a party by train and by coach over the dacite mountains to Marysville. Botanists, zoologists, and sightseers had a splendid, though somewhat arduous, time. Dr. C. S. Sutton and Mr. James Cuming, who was the host for the occasion, took a very large number by train to Warburton and Cement Creek. This is the home of big trees, though most of the giants have vanished. A visit was paid to the works of Messrs. Cuming, Smith and Co., where a number of chemical products from the eucalyptus are prepared on a fairly large scale. The naturalists revelled in the rich fern gullies with their wealth of zoological and botanical novelties.

A long day's excursion to the Macedon district was made possible by the generosity of the Automobile Club of Victoria, which provided cars. Prof. Skeats and Dr. Summers were the leaders, and the remarkable series of igneous rocks, for which the locality is famous, were well explored.

Prof. A. J. Ewart and Mr. R. Grimwade took a very large party by train along the narrow gauge track to Emerald. The mountain forest country was seen and large nurseries for raising fruit trees, and the Bosisto experimental oil-farm were visited. At the latter place, Messrs. Grimwade and Co. are cultivating scent plants, and have large experimental plantations of eucalyptus. Botanically, the excursion was a great success, as many typical Australian plants were seen.

A large party went by special train to Ballarat, the second city of the State. The mayors of the twin cities were most hospitable, and Mr. Wm. Baragwanath, the geological surveyor in charge of the district, demonstrated the leading features. The Government geologist, Mr. H. Herman, took another large party to Bendigo, where the famous "saddle" reefs were the chief source of attraction. The structure of the field was very clearly seen, and the lavish hospitality of the mayor and of the leading citizens was highly appreciated. Both here and at Ballarat, the plentiful loan of motor-cars made the inspection of wide areas of the surrounding country possible.

An excursion to the National Park at Wilson's Promontory, where 150 square miles of mountainous country is reserved as a sanctuary for animals and plants, had been planned by steamer. Almost at the last moment, the war troubles prevented the loan of the vessel. However, Mr. C. Catani, chief engineer of the Public Works Department, the leader, and especially Mr. J. A. Kershaw, curator of the National Museum, managed an overland transport, and the visit was thoroughly enjoyed by the small number who went.

Visits were paid to the Central Research Farm at Werribee under Dr. S. S. Cameron, Director of Agriculture, and to the Bacchus Marsh irrigated area under Dr. Elwood Mead.

Besides these official excursions, a large number were made under private guidance, and many special entertainments were given.

The meeting was, from all points, most successful; the Victorian members numbered 1998, and the details of organisation were under the control of Prof. Baldwin Spencer.

T. S. HALL.

NOTES.

THE Research Defence Society has prepared an instructive leaflet upon the subject of protection against typhoid fever, dealt with by the honorary secretary of the society, Mr. Stephen Paget, elsewhere in the present issue of NATURE. The society sends out supplies of this leaflet, and makes arrangements for providing the treatment, free of charge. Application should be made to the hon. secretary, Research Defence Society, 21 Ladbroke Square, London, W.

IT is reported by a Reuter message from Smyrna that an earthquake which occurred at midnight on Saturday, October 3, partly destroyed the towns of Isbarta and Burdur in the province of Konia, Asia Minor.

THE death occurred on September 30, at eighty-eight years of age, of Sir Henry Littlejohn, late president of the Royal College of Surgeons, Edinburgh, professor of forensic medicine in the University of Edinburgh in the years 1897–1906, medical officer of health for Edinburgh from 1862 to 1908, and the author of many publications on legal medicine and public health.

THE attention of our readers may be usefully directed to the joint propaganda of the Fisheries Organisation Society and the National Deep Sea Protection Association. These bodies have issued a reprint of an article, by Mr. Stephen Reynolds, on fish-food in wartime, and a series of very practical recipes and hints on cooking and buying fish, in which particular attention is directed to the use of cured herrings and other fish. The Board of Agriculture and Fisheries also issue leaflets relating to the further utilisation of fish and salted herrings as food. It is very desirable that the propagandist efforts to which we refer should be made as widely known as possible. Deep-sea fishing is suffering severely from the restriction of the fishing grounds, from actual war losses, and from the diversion of

very many vessels and men to the dangerous task of mine-sweeping; and with very great loyalty the fishing trade in general has combined to keep prices as low as possible. The herring fisheries are suffering even more severely from the loss of their great continental markets for salted fish: it will be unfortunate in every way if the yield of this industry should be gravely diminished, and the only hope seems to be in the securing of the normal stock of pickled herrings for domestic use and future trade, by the State. The Fisheries Organisation Society is an outcome of the recently published report of the Inshore Fisheries Committee: it aims at the further development of the smaller sea and coastal fisheries by various methods. Its offices are at Queen Anne's Chambers, Tothill Street, Westminster. At no other time than the present could this organisation be of greater service to the country, and we hope that many of our readers may be inclined to make themselves acquainted with its work.

WE have received from Mr. Francis Edwards, of 83 High Street, Marylebone, W., a catalogue of "books about birds," together with a certain number of publications of learned societies, the whole comprising between two and three hundred items.

ACCORDING to the *Victorian Naturalist* for August, an attempt is to be made to introduce the lyre-bird into Tasmania. Mr. D. le Souëf, who was consulted in regard to the probable cost of the experiment, gave the opinion that the birds could be trapped for about 5*l*. per pair, adding that suitable food during the period of confinement could be supplied by the Melbourne Zoological Gardens.

FREE-SWIMMING nematode and littoral oligochæte worms from the salt Chilka Lake, on the Orissa coast of Bengal, form the subject of two articles, respectively by Dr. F. H. Stewart and Major J. Stephenson, in vol. x., part 4, of Records of the Indian Museum. All the four genera of the former group found in the lake-fauna are cosmopolitan, and for the most part marine types; but at least four of the Chilka species, referable to three genera, are regarded as new.

IN vol. ii., No. 5, of the *Austral Avian Record*, the editor, Mr. G. M. Mathews, makes further emendations in his list of Australian birds. Among these may be noted the creation of no fewer than a dozen new generic names for various long-established species. To many naturalists this will seem an altogether unnecessary proceeding, and, in any case, such inelegant and unwieldy compounds as Purnellornis, Alphachlamydera, Alphacincla, and the like, are to be deprecated.

To the October number of the *Museums Journal* Dr. F. A. Bather contributes an instructive article on museums and national service, in which special reference is made to the various branches of research work now carried on at the Natural History Branch of the British Museum. The amount of work of direct practical utility yearly accomplished there would, it is claimed, surprise even those familiar with that establishment, attention being also directed to the cosmopolitan character of these researches. At present the museum has not a health department, with special facilities for bacteriological work and the practical study of hygiene; but it is suggested that such an addition would form an important extension of the museum's already manifold functions.

IN connection with the above, reference may be made to an article in the same issue by Mr. F. Leney, of the Norwich Museum, on the insurance of museums and their contents against fire and damage from other causes. The article formed the subject of a paper read at the recent Museum Conference at Swansea, where an instructive discussion took place at the close of the reading. Metropolitan Government museums are, we believe, uninsured, and the matter relates, therefore, solely to local institutions. The usual practice, it appears, is to insure the buildings separately from the collections, and generally against fire alone. Loan collections are, however, habitually insured against risks of all kinds. In the discussion, Dr. Hoyle referred to the progressive appreciation in value of many objects in museums, and the consequent automatic under-insurance of collections.

BIRD-SKINS in museums, it appears, form a rich hunting-ground for students of bird-lice (Mallophaga), as those parasites are generally preserved with the skins of the birds they infest. Advantage of this has recently been taken in the Indian Museum, Calcutta, where the store-skins of game-birds and the crow-tribe have been carefully searched, and the dried parasites picked out. The latter were sent to Prof. V. L. Kellog, of Stanford University, California, by whom and his colleague, Mr. J. H. Paine, the collection is described in vol. x., part 4, of Records of the Indian Museum. That the bird-lice found in any individual kind of bird-skin are really native to that particular species, appears, in most cases at any rate, to be beyond doubt, and, as the result of their study of the Calcutta collection, the authors of the paper have felt themselves justified in describing no fewer than thirteen species as new.

THE subject of "glazed frost" is always interesting, owing to its somewhat rare occurrence, and possibly to some extent to the uncertainty of part of the physical process involved in its formation. The term is now generally adopted for the smooth coating of ice which covers objects, and is usually formed when rain, consisting of super-cooled water drops, strikes the ground or other objects, but may "very occasionally" be formed in other ways. To the Journal of the Meteorological Society of Japan for May last Dr. T. Okada contributes some useful notes on the phenomenon, and quotes cases of its occurrence in that country, together with detailed observations. His calculation shows that, in the case under consideration, "the conduction and evaporation of raindrops falling through ice-cold layers of the atmosphere will be sufficient to cool them many degrees below the freezing point." As pointed out elsewhere by Mr. E. Gold, the difficulty appears to be to explain why small drops do not solidify in falling through the air.

IN the *Mathematical Gazette* for July (vi., 12), Prof. Harold Hilton proves that any twisted cubic curve may be displaced so that every point is moving perpendicular to its tangent, provided that the curve is screwed about a certain fixed axis.

THE resistance of road vehicles to traction is commonly regarded as the sum of two parts, one due to rolling friction on the ground and the other due to sliding friction at the axle. In a recent note (Venice, Carlo Ferrari, 1914) reprinted from the *Atti del R. Istituto veneto*, lxxiii. (2), pp. 931–46, Prof. T. Levi Civita, by considering the conditions of equilibrium, establishes the interdependence of these two resistances, and obtains new formulæ determining the total resistance. The title of the paper is "Sforze di regime e sforze d'avviamento per veicoli trainati."

FROM the Department of Lands and Surveys of Western Australia we have received a copy of its "Geodetic Tables." This publication contains two tables, of which one gives the logarithms of the number of links in 1″ of latitude, and of longitude, and the other gives the logarithms of the seconds of the arc-versines of spheroidal arcs of parallels 1″ in length. In each case the tables cover the range of 50° from the equator southwards. The tables are based on the auxiliary tables of the Survey of India, the values for the additional ten degrees having been specially computed. A short introduction explains the method of using them, and they should be of use to land surveyors who wish to control their work by means of the triangulation stations of the department.

IT was proved by Prof. Arnold Emch in the *American Journal of Mathematics* for October, 1913, that in every closed convex curve which is analytic throughout, at least one square can be inscribed. That at least one square can be circumscribed about such an oval curve is now proved by Prof. Tsuruichi Hayashi in the Bulletin of the American Mathematical Society, xx., 9, where he also obtains a parametric representation of the curve in tangential co-ordinates. His proof of the possibility of circumscribing the square about an oval curve is very simple. You can evidently circumscribe a rectangle having its sides parallel to any given direction. Now turn the direction round until the longer side becomes the shorter one. Then in some intermediate position the two sides will become equal, and the figure is then a square. It will be interesting and easy for mathematically inclined readers of NATURE to reconstruct from this material a corresponding proof for the inscribed square if they have not seen Prof. Emch's paper.

IN Yamagata, Japan, is a small lake called the Lake of the Floating Islands, discovered about the year 1340, which has from that time attracted the attention of many poets and literary men. A report on the mysterious movements of these islands drawn up by a party under Prof. S. Kusakabe is published in the Science Reports of the Tohoku Imperial University (Sendai), iii., 2. The floating islands, which at times number no fewer than sixty, are found to be continually changing their position, moving first one way and then the other. In the first series of observations, wooden floats were placed in the lake showing the distribution of the various currents; subsequently a model of the lake was constructed, and it was found possible closely to reproduce the various movements of the surface. When both water and wind currents were taken into account, the actual behaviour of the islands was found to be quite in accordance with theory and experiment. The islands originate from masses of vegetable *débris* which are first carried to the surface by bubbles of gas; then reeds commence to grow from seed on them; sometimes the mass becomes top-heavy and overturns, and reeds grow on the other side, until the island has grown sufficiently large in extent to secure stability.

THE September number of *Terrestrial Magnetism and Atmospheric Electricity* contains reports of the work done by the magnetic survey ship *Carnegie* during her second cruise round the world and during a more recent journey from New York along the Gulf Stream to Hammerfest. Along the line of the latter route the values of the deviation of the compass to the west of true north were found to be in general greater than the values given in the British and American charts by amounts which reach 1·3° in the former and 2·2° in the latter chart. The atmospheric electric observations taken during the voyage round the world lead to the conclusion that over the sea the potential gradient is of the same order as that over land, the radio-activity is smaller, while the specific conductivity is larger, than that over land. The conductivity appears to be independent of the radio-activity, although, like the radio-activity, it is greater for air which has been in contact with land than for air which has not during the week before the observations on it are made.

THE Journal of the Washington Academy of Sciences for August 19 contains two interesting optical papers. The first, by Prof. P. G. Nutting, of the Eastman Research Laboratory, gives the results of a series of measurements of the focal length of the human eye for light of different wave-lengths within the visible spectrum The author finds that while for a water lens the focal length increases by about 5 per cent. from the extreme blue to the red end of the spectrum at a rate which is fairly uniform, for many human eyes the increase, although of about the same amount, is confined to the ends of the range, the change over the middle half not exceeding 1 per cent., so that these eyes are nearly achromatic. The second, by Mr. F. E. Wright, of the Geophysical Laboratory, describes a new method of determining the refractive index of a mineral by the petrographic microscope. A stop below the condenser covers half the field, and its inverted image is formed between the stage and the low-power objective. In the same plane as this image a second stop is placed, and the distance of the edge of the second from that of the image of the first so adjusted that the field is nearly dark. In these circumstances, if a grain of mineral immersed in a liquid of refractive index not exactly equal with that of the mineral is placed on the microscope stage, the edges of the grain appear some

brighter, some darker, than the field, and a liquid having the same refractive index as the mineral can be quickly chosen.

PRACTICAL methods of determining the critical loads for long struts of varying section have attracted some attention recently. The latest contribution to the subject is given in an article in *Engineering* for October 2 by Messrs. L. Bairstow and E. W. Stedman, of the National Physical Laboratory. The method described seems to be comparatively easy to apply, and has the advantage of being applicable with equal ease to the simplest or to the most general case. It was devised originally for finding the critical loads of wooden struts as used in aeroplane construction. An assumed critical load for the strut is guessed or obtained by an approximate method such as taking Euler's law for a uniform strut of the average section. Curves for $-d^2y/dx^2$, dy/dx and y, which comply with the conditions imposed, are then drawn by a process of trial and error described in the article. If the assumed value of the critical load has happened to be correct, the ordinate of the dy/dx curve becomes zero at the middle of the strut (for a strut hinged at both ends). If the assumed value has been incorrect, the ordinate becomes zero at some other point. After two attempts, a very close approximation to the value of the critical load is reached.

ERRATUM.—In NATURE of September 24, p. 95, col. i., for Dr. S. N. Shannus read Dr. H. S. Stannus.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—The *Times* of October 3 publishes a telegram from South Africa announcing the discovery of a bright comet by Mr. Lunt at the Royal Observatory, Cape Town, on September 18. Mr. Wood, of Johannesburg, computed the orbit, and the following is the ephemeris given :—

	Right Ascension h. m. s.	Declination ° ′
Oct. 1 ...	22 48 48 ...	−26 44
5 ...	22 23 36 ...	17 41
9 ...	22 8 44 ...	11 11
13 ...	21 59 24 ...	−6 34

Perihelion passage took place on August 5. While the comet is decreasing its southern declination and reaching a better position for observation in this country its brightness is stated to be fading fairly rapidly owing to the increasing distance from the sun. On October 9 the comet will be situated in the constellation of Aquarius, a little below the third magnitude star gamma.

The following elements, based by Mr. Wood on observations made on September 21, 24, and 27, have been since communicated by the Royal Astronomical Society :—

$$T = 1914 \text{ Aug. } 4{\cdot}99 \text{ G.M.T.}$$
$$\left.\begin{aligned} \omega &= 270^\circ\ 19' \\ \Omega &= \ 0^\circ\ 22' \\ i &= 77^\circ\ 51' \end{aligned}\right\} 1914{\cdot}0$$
$$\log q = 9{\cdot}8543$$

COMET 1913*f* (DELAVAN).—Delavan's comet is now badly situated for evening observation, so most should be made of the morning hours. The object is rapidly decreasing its northern declination and moving westward, and will pass perihelion on October 26. It is now situated in the constellation of Canes Venatici, and on October 10 will not be far from the third magnitude star, 12 Canes Venaticorum. The following eight-day ephemeris is taken from *Knowledge* for August last :—

	Right Ascension h. m. s.	Declination ° ′
Oct. 10 ...	12 56 44 ...	+38 56
18 ...	13 37 56 ...	32 57
26 ...	14 11 50 ...	26 45
Nov. 3 ...	14 40 44 ...	+20 40

THE RETURN OF ENCKE'S COMET.—The short-period comet known as Encke's comet, for he it was who first calculated its elements, although Pons, of Marseilles, actually discovered it in the sky, was due to return this autumn, its period being about three and one-third years. It is now reported (*Daily Telegraph*, October 2) that it has been observed from the Russian Observatory at Simeis in the Crimea, this information having been received from Prof. Backlund, the director of the Pulkovo Observatory. It is situated in the constellation of Perseus. Encke's comet is of historical interest for several reasons. It was only the second instance of the recognised return of a comet, Halley's comet having preceded it by sixty-three years. It was also the first example of a new class of celestial objects revolving round the sun within the orbit of Saturn and exhibiting certain planetary affinities in the manner of their motions.

ENHANCED LINES AND THE PRESENCE OF HYDROGEN.—No. 85 of the Contributions from the Mount Wilson Solar Observatory is devoted to some electric furnace experiments on the emission of enhanced lines in a hydrogen atmosphere. The author, Mr. A. S. King, used in this research the vertical Rowland grating spectrograph described in this column on September 24. The experiments included the production of the enhanced lines with the furnace in a partial vacuum and in hydrogen at varying pressures up to one atmosphere, and the use of greatly different amounts of titanium. After describing the details of the experiments Mr. King sums up his results in three brief but interesting paragraphs. The experiments failed to show any effect of a hydrogen atmosphere in strengthening enhanced lines. The enhanced lines appear in the furnace at low pressures with equal ease whether hydrogen is present or whether the furnace contains a residue of air. No material effect on the relative intensities of enhanced lines is indicated, even when widely differing amounts of titanium vapour at low pressure and at the same temperature are employed. Increasing the pressure of hydrogen, the temperature being held as nearly constant as possible, causes a progressive weakening of the titanium enhanced lines, until at atmospheric pressure only traces of the strongest are visible in the furnace spectrum. Mr. King finally directs attention to the bearing of these results on the study of stellar atmospheres and the value of the strength of enhanced lines as a criterion not only for stellar temperatures but for different regions and levels of the solar photosphere.

THE LEEDS ASTRONOMICAL SOCIETY.—Vol. xxi. of the Leeds Astronomical Society contains the Journal and Transactions for the past year. The volume is edited by Mr. C. T. Whitmell, and gives a good account of the activity of this society. At each of the seven meetings which took place a paper on some definite subject was read, and these are reproduced more or less in full in this report. Thus some of the contributions dealt with the spectroscope, Uranus as a view-point, history of astronomy, etc. Other work of the society is summed up in the latter part of the volume.

GEOLOGY IN BRITISH AFRICA.

MEMOIR No. 6 of the Geological Survey of South Africa, by A. L. Hall, on "The Geology of the Murchison Range and District," deals with picturesque features of the Drakensberg scarp. Plate xv. finely illustrates the youthful nature of the Groot Letaba River (Fig. 1), which is represented (p. 29) as having cut back into the mature drainage-system of the M'Thlapitsi. The banded ironstones near Thabina (p. 66), associated with metamorphosed sediments, are regarded as also of sedimentary origin, although they are now composed of magnetite. We believe that this view must be generally accepted, and it has an obvious bearing on theories of the origin of the sheet-like magnetite ores of Sweden. Pp. 124 to 130 contain an interesting account of the formation of hybrid rocks between syenite, pyroxenite, and limestone. The limestone now contains olivine,

FIG. 1.—Gorge cut by the Groot Letaba River in its recession from the escarpment; the stream now receives water captured from the M'Thlapitsi.

magnetite, and apatite. The Olifants River mica-fields come within the scope of this memoir (p. 153). We notice (p. 19) that "neck" is used, perhaps unwisely, in its English form for a notch produced by weathering.

Sheet 13 of the geological map, and the accompanying memoir on "The Geology of the Haenertsberg Goldfields" (1914), are concerned with similar country, and the great scarp of the Black Reef quartzite appears conspicuously on the map. The memoir and map (Sheet 12) of the Pilandsberg, a great igneous centre north of the Witwatersrand and Rustenburg, are due to W. A. Humphrey, and direct attention to a region of great petrographic interest. The rocks have been previously described; they are syenites rich in alkalies, forming a great wall-like ring that surrounds a region of tuffs and lavas, also of the alkali type. Aegirine, leucite, and nepheline occur in the volcanic rocks. The ring suggests a "cauldron-subsidence," and an oozing up of matter along the marginal crack, as described by E. B. Bailey in the Cruachan area. The circular group of rocks is shown to be later than the Waterberg system, but has no kinship with the Drakensberg outflows. The map of this basal relic, sixteen miles across, forms one of the most striking lessons in volcanic structure with which we are acquainted.

The annual report of the Geological Survey of South Africa for 1912, published at the close of 1913, contains a summary by the director, H. Kynaston, both in Dutch and English, a memoir by him on the Marico and Rustenburg districts, one on the western Witwatersrand by E. T. Mellor, and a finely illustrated memoir by A. T. Hall on the country between Belfast and Middelburg. A. L. du Toit reports on Pondoland.

It is difficult in a few notes to do justice to the large amount of mineral and petrographic information issued regularly in the Transactions of the Geological Society of South Africa. In vol. xiv. (1912) p. 71, G. S. Corstorphine records a further occurrence of diamond in eclogite from the kimberlite pipe of the Roberts Victor Mine, Orange Free State. He still maintains that such eclogites are segregations from the peridotite (kimberlite) magma. C. T. Mellor (p. 99) contributes a detailed revision of the Lower Witwatersrand system, with a map and sections. He concludes that the conglomerates indicate a steady progression from deposits on the seaward margin of a delta up to true beaches on a shore. In vol. xv., p. 31, A. W. Rogers publishes his correlation of the Nieuwerust, Malmesbury, and Ibiquas Series of the Cape Province with the Nama system of German South-West Africa. The three series are now shown to have the sequence given above, the Nieuwerust beds being the oldest. P. Range's paper (p. 63) on the topography and geology of the German South Kalahari contains an interesting account of the nature of "pans." The author points out that good supplies of water are within reach of the dry lands of the Kalahari, in the Karroo and Nama beds that underlie the calcareous sandstone and dune-sand of the surface.

The Proceedings of the society include a lengthy discussion of Mr. Mellor's stratigraphical paper, and a presidential address by R. B. Young on the problem of the Rand Banket (1911, p. xxi.). Dr. Young argues against the detrital origin of the auriferous pyrite in the conglomerates. In vol. xv. (p. 83) he urges that the black colour of the quartz in the banket is due to dark inclusions, and he shows by thin sections how these are commonly related to shattered areas in the pebbles. The colour, then, arose after the vein-quartz had become included in the conglomerate.

Prof. Schwarz (*ibid.*, vol. xvi., 1913, p. 33) revives interest in the contacts of granite and schist near Cape Town, which were described by Playfair and Basil Hall in 1813, and by Clarke Abel in 1818. He does not mention Darwin's fruitful observations; but he accepts the view that the granite has absorbed the slates, and that the parallel flakes of biotitic matter represent residues from the sedimentary series. The advance of the granitic matter into the slate has allowed of the development (p. 35) of felspar crystals 2 in. long as replacements of digested matter. F. E. Studt provides (p. 41) an important regional paper on Katanga and Northern Rhodesia, involving a review of South African structure as a whole. He believes that the extensive lava-flows of East Africa were connected with subsidences which date back to Middle

Carboniferous times (p. 95), and that the Karroo strata of Katanga and Rhodesia were formed in the lowered areas. The "graben" of the great lake region is of much younger age. H. S. Harger, in his presidential address (vol. xvi., p. xxii.), points out that the Drakensberg lavas are of Jurassic age, and probably extended at one time right across the Free State. He is concerned with the immense amount of subsequent denudation, but does not explain how the "vast peneplain" over the entire Karroo (p. xxviii.) came about, if the surface remained high above sea-level. A great inland lake might, of course, supply a base-level. He contrasts the periods of great river-action with those of subsequent desiccation, and gives striking illustrations of denudation by sand-storms in German South-West Africa. May we ask that this energetic society should consider those members who cannot promptly bind the Transactions? They have a way of falling to pieces when one cuts the pages which renders them very liable to denudation.

F. Oswald, well known for his researches in Armenia, has described "The Miocene Beds of the Victoria Nyanza and the Geology of the Country between the Lake and the Kisii Highlands" (Quart. Journ. Geol. Soc. London, vol. lxx., 1914, p. 128). His journey through a fly-infested region was undertaken to collect vertebrate remains from lacustrine strata, which underlie extensive flows of nepheline-basalt. C. W. Andrews describes the mammalia, including Dinotherium and two anthracotheres, and R. Bullen Newton shows that the associated freshwater mollusca represent existing species. The mammalia, however, assign the deposits, which were formed probably in a delta, to the Burdigalian epoch, and the history of the Victoria Nyanza is thus carried back into the middle of Cainozoic time.

R. B. Newton enters the African field in another paper (Records of the Albany Museum, Grahamstown, vol. ii., 1913, p. 315), in which he shows that the extensive Alexandria formation of the Cape Province is of Cainozoic age, and distinct from the Cretaceous strata occurring near East London. Several new molluscan species are represented in a beautiful series of photographic plates.

A. E. V. Zealley ("Zinc and Lead Deposits of Broken Hill, N. Rhodesia," South African Journ. Sci., vol. viii., 1912, p. 396), remarks that the phosphates in this area, including the beautiful deposits of hopeite, are connected with the decomposition of a bone-breccia, and that vanadinite arises in connection with the zinc and lead phosphates in a way which suggests that vanadium occurs also in the bones.

THE INSTITUTE OF METALS.

IN the study of the constitution of alloys, as well as in the practical and commercial use of both pure metals and alloys, that form of heat treatment known as annealing plays an important part, and a complete knowledge of the effects of various temperatures and conditions of annealing is of vital importance. This statement is not invalidated by the fact that many of our large metal works conduct their annealing operations in the most crude and haphazard way, a state of affairs which is, happily, becoming a thing of the past. In this connection it is interesting to note that one-third of the papers read at the recent meeting of the Institute of Metals deal, to a greater or less extent, with this important subject. J. Phelps shows that the presence of hydrogen in the atmosphere surrounding silver which is being annealed, increases the temperature required to obtain complete softness in thirty minutes, from below 150° C. to about 300° C. F. Johnson emphasises the necessity of annealing Admiralty brass castings to a temperature of about 700° C. Bengough and Hanson show that copper tested to destruction in an oxidising atmosphere has an elongation four times as great, and a maximum stress one-third as great, as that obtained when the test is carried out in a neutral atmosphere such as carbon dioxide.

Bengough and Hanson's paper also contains much interesting information as to the tensile properties of copper at high temperatures. They show that this metal fits in very well, on the whole, with Rosenhain's amorphous theory, the fracture changing from a ductile, crystalline one at low temperatures, to a non-ductile, intercrystalline, and very brittle one at high temperatures. A remarkable difference, however, is that Rosenhain and Ewen found that the intercrystalline fracture occurred within a few degrees of the melting point, whereas the present workers have found that, in the case of copper, it is evident as low as 720° C., or about 350° C. below the melting point.

From time immemorial, manufacturers of zinc-copper alloys have known that, at temperatures somewhat below a red heat, 60/40 brass becomes very brittle, recovering its normal strength as it cools. This fact was referred to by Bengough and Hudson in a paper read to the Institute of Metals in September, 1910. At the next meeting Carpenter and Edwards showed that there was an arrest point occurring at about 470° C. in the heating and cooling curves of this alloy. They pointed out that this could be explained by assuming either (1) that there was a polymorphic modification of the β constituent at this temperature, or (2) that the β splits up into $\alpha+\gamma$. On microscopic and other grounds they accepted the latter view. In the discussion which followed the reading of the paper, Mr. Hudson, amongst others, confessed himself unable to accept Prof. Carpenter's interpretation. Since then the fray has raged more or less continuously between the supporters of the two theories, and at this meeting. a paper has been read by Mr. Hudson, which, in the opinion of the writer, definitely settles the question in favour of the polymorphic theory. Briefly, the β constituent has been synthetised from α and γ at temperatures below 470° C., *i.e.* at a temperature at which the "decomposition theory" supposes that it does not exist in equilibrium. This result was obtained by annealing a piece of 70/30 brass in contact with a piece of zinc at a temperature ranging between 420° C. and 430° C.; after annealing for several days, a section was cut at right angles to the junction of the two metals, and it was found that β was present.

The third part of Arnold Phillip's "Contribution to the History of Corrosion" consists in a refutation of the statement (made by Bengough and Jones in their "Report to the Corrosion Committee") that coke in condenser tubes does not promote corrosion. He brings forward evidence to prove that the reverse is the case.

Thorneycroft and Turner continue the work commenced some years ago by Prof. Turner on the volatility of metals *in vacuo*. The present paper describes the results of experiments on the zinc-copper series, and the authors show that those alloys containing more than 40 per cent. of copper can be quantitatively separated into their constituent metals by distillation *in vacuo*, while in the case of those which contain less than 40 per cent., part of the copper comes over with the zinc.

Amongst other papers read at the meeting is an interesting one by Captain Belaiew, which has been reprinted already in NATURE (p. 107), a description of the Schoop process of spraying metals by R. K. Morcom, and a paper by S. W. Smith on the surface tension of molten metals. J. L. H.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE.

Crosby Lockwood and Son.—Agriculture: Extensive and Intensive, Prof. J. Wrightson, in conjunction with J. C. Newsham. *Longmans and Co.*—Fungoid Diseases of Farm and Garden Crops, Drs. T. Milburn and E. A. Bessy, illustrated. *Macmillan and Co., Ltd.*—The Principles of Irrigation Practice, Dr. J. A. Widtsoe, illustrated; Stock Judging, C. W. Gay, illustrated; Agricultural Grasses, A. S. Hitchcock, illustrated. *Methuen and Co, Ltd.*—Agricultural Analysis, H. D. Grist, illustrated. *John Murray.*—Elements of Agriculture, the late Dr. W. Fream, new edition, edited by J. R. Ainsworth-Davis, illustrated.

ANTHROPOLOGY AND ARCHÆOLOGY.

Duckworth and Co.—Where Animals Talk: Folk Tales of West Africa, Rev. R. H. Nassau. *Macmillan and Co., Ltd.*—The German Excavations at Babylon, R. Koldewey, translated by Agnes S. Johns, illustrated; An Introduction to Field Archæology as Illustrated by Hampshire, Dr. J. P. Williams-Freeman, illustrated. History of Upper Assam, Upper Burmah, and North-Eastern Frontier, Col. L. W. Shakespear, illustrated; General Index to "The Golden Bough: A Study in Magic and Religion," Sir J. G. Frazer; Outa Karel's Stories: South African Folk-Lore Tales, S. Metelerkamp, illustrated. *Williams and Norgate.*—The Antiquity of Man, Prof. A. Keith, illustrated.

BIOLOGY.

D. Appleton and Co.—Plant Breeding, J. M. Coulter, illustrated. *A. and C. Black.*—Wild Life in the Woods and Streams, C. A. Palmer, illustrated; Visual Botany, A. Nightingale, illustrated. *J. and A. Churchill.*—Plant Life in the British Isles, A. R. Horwood, vols. ii. and iii., illustrated. *J. M. Dent and Sons, Ltd.*—Reptiles and Batrachians, E. G. Boulenger, illustrated; A History of Botany in the United Kingdom, Dr. J. R. Green. *W. Heinemann.*—The Romance of the Beaver, A. R. Dugmore, illustrated. *Hodder and Stoughton.*—The Mason Bees, J. H. Fabre. *H. Holt and Co. (New York).*—Essentials of College Botany, Profs. C. E. and E. A. Bessey; Economic Zoology and Entomology, Profs. V. L. Kellogg and R. W. Doane; Biology, Prof. G. N. Calkins. *John Lane.*—Birds of the Indian Hills, D. Dewar. *Longmans and Co.*—British Birds, written and illustrated by Archibald Thorburn, with 80 plates in colour, showing more than four hundred species, in four vols.; Report on the Scientific Results of the *Michael Sars* North Atlantic Deep Sea Expedition, 1910, carried out under the auspices of the Norwegian Government and the superintendence of Sir John Murray and Dr. J. Hjort. *Macmillan and Co., Ltd.*—A Treatise on Embryology, edited by W. Heape, vol. i., Invertebrata, Prof. E. W. MacBride, illustrated; Zoological Philosophy: an Exposition with regard to the Natural History of Animals, the diversity of their organisation and the faculties which they derive from it; the physical causes which maintain life within them and give rise to their various movements; lastly, those which produce feeling and intelligence in some among them, J. B. Lamarck, translated, with an introduction, by H. S. Eliot; Transpiration and the Ascent of Sap in Plants, Prof. H. H. Dixon, illustrated; The Coco-Nut, Prof. E. B. Copeland, illustrated; Manual of Weeds, A. E. Georgia, illustrated; Plant Breeding, Profs. L. H. Bailey and A. W. Gilbert, illustrated; Household Insects, G. W. Herrick, illustrated. *A. Melrose, Ltd.*—The Wonder of Life, Prof. J. A. Thomson, illustrated. *Methuen and Co., Ltd.*—Diversions of a Naturalist, Sir E. Ray Lankester, illustrated; Science from an Easy Chair, Sir E. Ray Lankester, second series, illustrated. *John Murray.*—Trees and Shrubs Hardy in the British Isles, W. J. Bean, two vols., illustrated; Life-Histories of African Game Animals, T. Roosevelt and E. Heller, two vols., illustrated. *Grant Richards, Ltd.*—Insects and Man: a Concise Account of the More Important Relations Existing between the Insect World and the Human Race, C. H. Ealand, illustrated. *The S.P.C.K.*—Floral Rambles in Highways and Byways, Rev. Prof. G. Henslow, illustrated. *The University Tutorial Press, Ltd.*—Junior Botany, Dr. F. Cavers. *John Wiley and Sons, Inc. (New York).*—Elements of Forestry, Profs. F. F. Moon and N. C. Brown.

CHEMISTRY.

D. Appleton and Co.—Chemistry in America, E. F. Smith. *A. and C. Black.*—Chemical Analysis, Qualitative and Quantitative, G. G. Gardiner, illustrated. *Cambridge University Press.*—The Chemical Examination of Water, Sewage, Foods, and other Substances, J. E. Purvis and T. R. Hodgson (Cambridge Public Health Series). *J. and A. Churchill.*—Explosives: their Manufacture, Properties, Tests and History, A. Marshall; The Chemistry of the Cyanogen Compounds, and their Manufacture and Estimation, H. E. Williams. *Gurney and Jackson.*—Technical Gas-Analysis, Dr. G. Lunge, illustrated; Technical Methods of Chemical Analysis, edited by Dr. G. Lunge, vol. iii., two parts; English Translation from the Latest German Edition, adapted to English Conditions of Manufacture, edited by Dr. C. A. Keane, illustrated. *H. Holt and Co. (New York).*—Laboratory Directions for Elementary Chemistry, H. I. Mattill. *Crosby Lockwood and Son.*—The Practical Chemistry of Petroleum and its Substitutes, Drs. C. K. Tinkler and F. Challenger, illustrated. *Sampson Low and Co., Ltd.*—The Wonderland of Modern Chemistry, Dr. G. Martin, together with a chapter on "Thermit" and its Applications, by H. S. Redgrove, illustrated. *Methuen and Co., Ltd.*—Practical Physical Chemistry, J. B. Firth; Preparations and Exercises in Inorganic Chemistry, W. Lowson; A Senior Experimental Chemistry, Drs. A. E. Dunstan and F. B. Thole, illustrated. *John Wiley and Sons, Inc. (New York).*—Text-Book of Physiological Chemistry, Prof. O. Hammarsten and S. G. Hedin, translated by Prof. J. A. Mandel, new edition; The Elements of Physical Chemistry, Prof. J. L. R. Morgan, new edition; Micro-Chemical Methods, Prof. E. M. Chamot.

ENGINEERING.

Constable and Co., Ltd.—A Study of the Circular Arc-Bow-Girder, Prof. A. H. Gibson; Masonry Applied to Civil Engineering, F. N. Taylor, illustrated. *Crosby Lockwood and Son.*—Large Electric Power Stations, Prof. Klingenberg; The Mine Wagon and its Lubrication, C. Pamely; Electric Lighters and Starters for Autocars, H. U. Cross; The Heating Power of Boilers, Economisers, and Superheaters, Prof. R. H. Smith, illustrated; Water Supplies: Their Purification, Filtration, and Sterilisation, Drs. S. and E. Rideal; Civil Engineering Types and Devices, T. W. Barber, illustrated. *Longmans and Co.*—Specification and Design of Dynamo-Electric Machinery, Prof. M. Walker, illustrated; Ropeways: their Construction and Working, P. Stephan, translated by Dr. R. F. Muirhead, illustrated; Some Considerations Regarding Cast-Iron and Steel Pipes, J. Sharp. *Scott, Greenwood and Son.*—Steam Boilers, J. Batey. *The University Tutorial Press, Ltd.*—Electrical Engineering, W. T. Maccall. *Whittaker and Co.*—Electric Light Fitting, Batstone; Polyphase Currents, Still, new edition; Alternating Current

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THE AUSTRALIAN MEETING OF THE BRITISH ASSOCIATION.

SECTION M.

AGRICULTURE.

ADDRESS BY A. D. HALL, M.A., F.R.S., PRESIDENT OF THE SECTION.

THE president of a section of the British Association has two very distinct precedents before him for his address; he can either set about a general review of the whole subject to which his section is devoted, or he can give an account of one of his own investigations which he judges to be of wider interest and application than usual. The special circumstances of this meeting in Australia have suggested to me another course. I have tried to find a topic which under one or other of its aspects may be equally interesting both to my colleagues from England and to my audience who are farming here in this great Continent. My subject will be the winning of new land for agriculture, the bringing into cultivation of land that has hitherto been left to run to waste because it was regarded as unprofitable to farm. To some extent, of course, this may be regarded as the normal process by which new countries are settled; the Bush is cleared and the plough follows, or under other conditions the rough native herbage gives way to pasture under the organised grazing of sheep or cattle. I wish, however, to deal exclusively with what are commonly termed the bad lands, inasmuch as in many parts of the world, though recently settled, agriculture is being forced to attack these bad lands because the supply of natural farming land is running short. In a new country farming begins on the naturally fertile soils that only require a minimum of cultivation to yield profitable crops, and the new-comers wander further afield in order to find land which will in the light of their former experience be good. Before long the supply is exhausted, the second-class land is then taken up until the stage is reached of experimentation upon soils that require some special treatment or novel form of agriculture before they can be utilised at all. Perhaps North America affords the clearest illustration: its great agricultural development came with the opening up of the prairies of the Middle West, where the soil, rich in the accumulated fertility of past cycles of vegetation, was both easy to work and grateful for exploitation. But with the growth of population and the continued demand for land no soils of that class have been available for the last generation or so, and latterly we find the problem has been how to make use of the arid lands, either by irrigation or by dry-farming where the rainfall can still be made adequate for partial cropping, or, further, how to convert the soils that are absolutely poisoned by alkali salts into something capable of growing a crop. You yourselves will supply better than I can the Australian parallels; at any rate we in England read that the wheat-belt is now being extended into districts where the low rainfall had hitherto been thought to preclude any systematic cropping.

Now, the fact that the supply of naturally fertile land is not unlimited reacts in its turn upon the old countries. During the 'eighties and 'nineties of the last century the opening up of such vast wheat areas in America, Argentina, Australia, and the development of the overseas trade, reduced prices in Europe to such an extent that in Great Britain, where the full extent of the competition was experienced, the extension of agriculture came to an end despite the continued increase of population. The area of land under cultivation has declined but little despite the growth of the towns, but the process of taking in the waste lands stopped, and much of the land already farmed fell back from arable to cheaper pasture. But as soon as production in the newer countries failed to keep pace with the growth of population, prices began to rise again, and we are now in the Old World endeavouring to make productive the land that has hitherto been of little service except for sport and the roughest of grazing. Even the most densely populated European countries contain great areas of uncultivated land; within fifty miles of London blocks of a thousand acres of waste may be found, and Holland and Belgium, perhaps the most intensively cultivated of all Western

countries, possess immense districts that are little more than desert. Of the European countries, Germany has taken the lead in endeavouring to bring into use this undeveloped capital; her population is rising rapidly, and her fiscal policy has caused her to feel severely the recent increase in the prices of foodstuffs, which she has determined to relieve so far as possible by extending the productivity of her own land. It has been estimated that Germany possesses something approaching to ten million acres of uncultivated land, and a Government department has been created to reclaim and colonise this area.

Before dealing with the processes by which the rough places of the earth are to be made straight, there is one general question that deserves consideration: Is it more feasible to increase the production of a given country by enlarging the area under cultivation, or by improving the methods of the existing cultivators? There is without doubt plenty of room for the latter process even in the most highly farmed countries: in England the average yield of wheat is about 32 bushels per acre—a good farmer expects 40; the average yield of mangolds, a crop more dependent upon cultivation, is as low as 20 tons per acre when twice as much will not be out of the way with good farming. A large proportion of the moderate land in England is kept in the state of poor grass—even as grass its production might be doubled by suitable manuring and careful management, while under the plough its production of cattle-food might easily be trebled or quadrupled. Why, then, trouble about adding to the area of indifferent land when so much of what has already been reclaimed, upon which the first capital outlay of clearing, fencing, roadmaking, etc., has been accomplished, is not doing its duty? We are at once confronted by the human factor in the problem. The existing educational agencies which will have to bring about better farming will only slowly become effective, and however imperfect they still may be in England, they are mainly so because of the lack of response upon the part of the farmers. The present occupiers of the land do obtain in many cases a very inadequate return from it, but they make some sort of a living and they hold it up against others who, though they want land, cannot be guaranteed to use it any better. Improved farming means more enterprise, more knowledge, often more capital, and the man who can bring these to the business is far rarer than the man who, given a piece of land even of the poorest quality, will knock a living out of it by sheer hard work and doggedness. While, then, there should be no slackening in our efforts to improve the quality of the management of existing land, there is a case for also using every effort to increase the cultivable area; indeed, it is probable that for some time to come the second process will add most to both the agricultural production and the agricultural population.

Let us now consider what are the factors which determine the fertility of the land that is first brought into cultivation and remains the backbone of farming in the old settled countries. Foremost comes rainfall, and the distribution is almost as important as the amount. Winter rain is more valuable than summer, and though cereal-growing is none the worse and may even obtain better results with a rainless summer, stock-raising and the production of fodder crops are the better for a rainfall that is distributed fairly evenly throughout the year. Rainfall, again, must bear some relation to temperature; some of the best farming in the Eastern Counties of England is done on an average rainfall of 20 inches; there are great areas in South Africa with the same average rainfall that are little better than desert. In temperate regions we may say that the naturally fertile land requires a rainfall of from 20 to 50 inches per annum, not too much segregated into seasons, and some at least falling in the winter.

If the rainfall is excessive or the drainage inadequate to carry it off, the formation of peat is induced, resulting in such uncultivated areas as the bogs of Ireland and the moors of Eastern England, Holland, and Germany.

Given suitable rainfall and temperature the texture of the soil becomes a factor of importance; if too coarse and sandy, so little of the rainfall is retained that we get all the effects of drought secondarily produced. In itself the open texture of a coarse, sandy soil is favourable to plant development; under irrigation, or where the situation is such as to result in permanent water a short distance below the surface, fine crops will be produced on sandy soils that would remain almost barren if they only depended upon the rainfall for their water. In Western Europe large areas of heaths and waste land owe their character to the coarse and open texture of the soil. At the opposite extreme we find clays so heavy that their cultivation is unprofitable; such soils, however, will carry grass and are rarely left unoccupied. For example, in the south-east of England there are a few commons, *i.e.*, land which has never been regarded as worth enclosing and bringing into particular ownership, situated on heavy clay land; most of such land is pasture, often of the poorest, or, if at any elevation, has been covered with forest from time immemorial.

One last factor in the soil is of the utmost importance to fertility, and that is the presence of lime—of calcium carbonate, to be more accurate—in quantities sufficient to maintain the soil in a neutral condition. Old as is the knowledge that lime is of value to the soil, we are only now beginning to realise, as investigation into the minute organisms of the soil proceeds, how fundamental is the presence of lime to fertility. A survey of the farming of England or western Europe will show that all the naturally rich soils are either definitely calcareous or contain sufficient calcium carbonate to maintain them in a neutral condition even after many centuries of cultivation. Examples are not lacking where the supply of calcium carbonate by human agency has been the factor in bringing and keeping land in cultivation. I have discussed one such case on the Rothamsted estate, and several others have come under my notice. The amelioration of non-calcareous soils by treatment with chalk or marl from some adjacent source has been a traditional usage in England and the North of France: Pliny reports it as prevailing in Gaul and Britain in his day, and the farmer of to-day often owes the value of his land to his unknown predecessors who continuously chalked or marled the land. Upon the presence of carbonate of lime depends the type of biological reaction that will go on in the soil, the beneficial bacterial processes that prepare the food for plants only take place in a medium with a neutral reaction. The Rothamsted soils have provided two leading cases. I have shown that the accumulation of fertility in grass-land left to itself and neither grazed nor mown, so that virgin conditions were being re-established, was due to the action of the organism called Azotobacter, which fixes free nitrogen from the atmosphere, and was indirectly determined by the presence of calcium carbonate in the soil, without which the Azotobacter cannot function. Examination of typical examples of black soils from all parts of the world, the prairies of North America, the steppes of Russia and the Argentine, New Zealand and Indian soils, showed in all of them the Azotobacter organism and a working proportion of carbonate of lime. Now, as we know, all virgin soils are not rich, and only in a few parts of the world are to be found those wonderful black soils that are often several feet in depth

and contain 10 to 20 per cent. of organic matter and 3 to 5 parts per thousand of nitrogen. These soils are all calcareous, they occur in regions of a moderate rainfall inducing grass-steppe or bush conditions, and the annual fall of vegetation provides the organic matter which the Azotobacter requires as a source of energy in order to fix nitrogen. Non-calcareous soils under similar climatic conditions do not accumulate nitrogen and become rich; in the absence of carbonate of lime the nitrogen-fixing organisms are not active, and the soil only receives from the annual fall of vegetation the nitrogen that was originally taken from it. There is but a cyclic movement of nitrogen from the soil to the plant and back again, whereas in the calcareous soils there is also continuous addition of fresh nitrogen derived from the atmosphere, in which process the carbonaceous part of the annual crop supplies the motive power.

The other leading case to be found at Rothamsted is that of certain grass-plots which have artificially been brought into an acid condition by the continued application of sulphate of ammonia. In these soils nitrification is suspended, the nitrification organisms have even disappeared, though the herbage still obtains nitrogen because most plants are able to utilise ammoniacal nitrogen as well as nitrates. The interesting feature, however, is that the decaying grass on these acid soils passes into the form of peat, a layer of which is forming upon the surface of the soil, though nothing of the kind is found on adjacent plots where the use of lime or of alkaline manures has prevented the development of acidity. From this we may learn that the development of a surface layer of peat, independent of waterlogging (when another kind of peat forms even under alkaline conditions), is determined by the acidity of the soil, when certain of the bacterial processes of decay are replaced by changes due to micro-fungi which do not carry the breaking-down of organic matter to the destructive stage. This affords us a clue to the origin of many areas of upland peat in the British Isles, where the remains of ancient forest roots and stumps of trees are found on the true soil surface below the layer of peat, but where there is no water-logging to bring about the death of the trees and the formation of peat. We may suppose that when the land-surface became fit for vegetation at the close of the glacial epoch it covered itself with a normal vegetation, chiefly dwarf forest, because of the rainfall and temperature. The soil, however, being without carbonate of lime, would in time become acid with the products of decay of the vegetable matter falling to the ground, and as soon as this acid condition was set up peat would begin to form from the grassy surface vegetation. The process would continue until the acid conditions and the depth of the accumulating layer of peat would kill the trees, the stumps of which would remain sealed up below the peat. I am far from thinking that this explanation is complete, but at least we have facts in sight which could lead one to suppose that a non-calcareous soil originally neutral and carrying a normal vegetation can naturally become acid, alter the character of its vegetation, and clothe itself with a layer of peat. The point of economic importance is that these peaty acid soils are of very little value as long as they are acid, though they take on a quite different aspect if they are limed and made neutral.

Of all the soil factors making for fertility I should put lime the first; upon its presence depend both the processes which produce available plant food in quantities adequate for crop-production at a high level and those which naturally regenerate and maintain the resources of the soil; it is, moreover, the factor which is most easily under the control of the agriculturist.

I need say little about those cases in which infertility is due to the presence in the soil of some substance which is actually injurious to plant-growth, because such substances are nearly always due to the physical environment of the soil, to too much or too little water. In waterlogged situations we may find in the soil peaty acids, iron salts, sulphides, etc., inhibiting the growth of plants; in arid regions the soil may still be charged with an excess of soluble compounds of the alkalis and alkaline earths, resulting from the decomposition of the rocks that have been broken down to form the soil, but which through the inadequate rainfall have never been washed out. The establishment of normal conditions of growth, irrigation in one case, drainage in the other, will speedily result in the removal of the deleterious substances. Practically, only bodies that are soluble can get into a plant to injure it, hence such bodies can be removed from the soil by water, provided that the water can find its way through the soil and escape.

Let us now consider the various methods by which land suffering from one or other of the disabilities we have just discussed is nowadays being brought into cultivation. The most important, if we consider the area affected, is the extension of cropping into regions of a deficient rainfall by means of what has been termed dry-farming. So far as its immediate methods go, dry-farming consists in nothing more than the application of the principles of husbandry worked out by English farmers in the east and south-east of England, principles first expounded by Jethro Tull, though a complete explanation was not then possible, even if it is now. In the first place, the tilth must be made both deep and fine, thus whatever rain falls will be absorbed and the conditions favouring a deep and full root range will have been established. Next, the soil below the surface, though finely worked, must be compact, because only thus can the water present travel to the roots of the plant. Lastly, a loose layer must be maintained on the surface, which, though dry itself, acts as a screen and a barrier to prevent loss of water from the effective soil below by any other channel than that of the plant. Granted these methods of cultivation, the new feature about "dry-farming," which has been introduced by settlers in the arid districts of Australia and North America, is the use of a year of bare fallow in which to accumulate a supply of water for the next year's or two years' crop. This raises the fundamental question of how much water is necessary for the growth of an ordinary crop. The first investigation that Lawes and Gilbert carried out at Rothamsted dealt with this very point; they grew the usual field crops in pots, protected the surface of the soil from evaporation so that all the loss of water proceeded through the plant, weighed the water that was supplied from time to time, and finally weighed the produce, expressing their results as a ratio between the dry matter produced and the water transpired by the plant. These experiments have been repeated under different climatic conditions by Hellriegel in Heidelberg, by Wollny in Vienna, by King and others in America. Now the two processes in the plant, carbon assimilation and transpiration, are not causally connected, though, as both are carried out in the leaf and have some factors in common, they are found to show some constancy in their relative magnitudes. Lawes and Gilbert obtained a ratio of about 300 lb. of water transpired for each pound of dry matter harvested, but the other investigators under more arid conditions found much higher figures, up to 500, and even 700 to 1. Now, a crop yielding 20 bushels of wheat per acre will contain about a ton of dry matter per acre, so that, taking the high ratio of 500 to 1,

no more than 500 tons of water per acre or 5 in. of rain will have been consumed in the production of this crop.

It is, of course, impossible to ensure that all the rain falling within a year shall be saved for the crop; much must evaporate before it reaches the subsoil where it can be stored, and only when the crop is in full possession of the land can we expect that all the water leaving the soil shall go through the crop. What proportion the waste bears to that which is utilised will depend not only on the degree of cultivation, but upon the season at which the fall occurs; summer showers, for example, that do not penetrate more than a few inches below the surface will be dissipated without any useful effect. When the climatic conditions result in precipitation during the winter, the water will be in the main available for crop-production; and it has been found by experience that cereals can be profitably grown with as small a rainfall as 12 in. The necessary cultural operations consist in producing such a rough surface as will ensure the water getting into the subsoil; hence autumn ploughing is desirable. Where the precipitation is largely in the form of snow, a broken surface also helps both to absorb the thawing snow and to prevent it being swept into the gullies and hollow places by the wind. On some of the Russian steppes it has become customary to leave a long stubble in order to entangle as much snow as possible, but probably a rough ploughing before the snowfall would be even more effective. When the rainfall drops to the region of 12 to 16 in., and occurs during the summer months, then dry-farming methods and the summer fallow become of the first importance. The deep cultivation ensures that the water gets quickly down to the subsoil away from danger of evaporation, and the immediate renewal of a loose surface tilth is essential in order to conserve what has thus been gained.

In connection with this dry-farming there are several matters that still require investigation before we can decide what is the minimum rainfall on which cultivation can be profitable. In the first place, we are only imperfectly informed as to the relation between rainfall and evaporation. At Rothamsted there are three drain-gauges side by side, the soil layers being 20, 40, and 60 in. deep respectively. The surface is kept rough and free from growth, though scarcely in the condition of looseness that could be described as a soil mulch. Yet the evaporation, even under a moist English atmosphere, amounts to one-half of the annual rainfall, and the significant thing is that the evaporation is approximately the same from all the gauges and is independent of the depth of subsoil within which water is stored. Evaporation then would seem to be determined by surface alone, but we are without systematic experiments to show how variations in the surface induced by cultivation will alter the rate of evaporation. A knowledge of the evaporation factor would then inform us of what proportion of the rainfall reaches the subsoil; we then want to know to what extent it can be recovered, and how far it may sink beyond the reach of the crop. It is commonly supposed that the subsoil below the actual range of the roots of the crop may still return water by capillarity to the higher levels that are being depleted, the deeper subsoil thus acting as a kind of regulating reservoir absorbing rain in times of excess and returning it when the need arises. But some work of Leather's in India and Alway's on the great plains of North America throw doubt on this view, and would suggest that only the layer traversed by roots, say, down to a depth of 6 ft., can supply water to the crop; the water movements from the deeper layers due to capillarity being too slow to be of much effect in the maintenance of the plant. The evidence on either side is far from being conclusive, and more experiment is very desirable.

It would also be valuable to know how far evaporation from the bare soil can be checked by suitable screens or hedges that will break the sweep of the wind across the land. In England hedges have always been looked at from the point of view of shelter from stock; we find them most developed in the grazing districts of the west, while bare, open fields prevail in the east and south. Yet the enormous value of a wind-screen to vegetation can be readily observed, and the market-gardeners both in England and the still dryer districts of the south of France make great use of them. Lastly, we must have more knowledge about the relation between transpiration-water and growth; we do not know if the high ratios we have spoken of hold for all plants. Xerophytic plants are supposed to be possessed of protective devices to reduce loss of water. Are they merely effective in preserving the plant from destruction during the fierce insolation and drying it receives? and do they enable a plant to make more growth on a given amount of water? Wheat, for example, puts on its glaucous, waxy bloom under dry conditions: Is this really accompanied by a lower rate of transpiration per unit surface of leaf? and is it more than defensive, connoting a better utilisation of the water the plant evaporates?

The cultivation of these soils with a minimum rainfall necessitates varieties of plants making a large ratio of dry matter to water transpired, and also with a high ratio between the useful and non-useful parts of the plant. Mr. Beaven has shown that the difference in the yields of various barleys under similar conditions in England are due to differences in their migration factors: the same amount of dry matter is produced by all, but some will convert 50 per cent. and others only 45 per cent. into grain. This migration ratio, as may be seen by the relation between corn and straw on the plots at Rothamsted, is greatly affected by season; nevertheless, Mr. Beaven's work indicates that under parallel conditions it is a congenital characteristic of the variety, and therefore one that can be raised by the efforts of the plant-breeder. The needs of dry-land farming call for special attention on the part of the breeder to these two ratios of transpiration and migration.

Closely linked up with the problems of dry-land farming are those which arise in arid climates from the use of irrigation water on land which is either impregnated with alkaline salts to begin with or develops such a condition after irrigation has been practised for some time. The history of irrigation farming is full of disappointments due to the rise of salts from the subsoil and the subsequent sterility of the land, but the conditions are fully understood, and there is no longer any excuse for the disasters which have overtaken the pioneers of irrigation in almost every country. Sterility may arise from two causes—overmuch water, which brings the water-table so close to the surface that the plants' roots may be asphyxiated, or the accumulation by evaporation of the soluble salts in the surface layer until plants refuse to grow. The annual cutting off of the cotton crop in Egypt as the water-table rises with the advance of the Nile flood affords a good example of asphyxiation, but in the neighbourhood of irrigation canals we also find many examples of sterility due both to the high water-table and an accompanying rise of salts. The governing principle is that drainage must accompany irrigation. Even if free from salts at the outset, the land must accumulate them by the mere evaporation of natural waters, and they will rise to the surface where they exert their worst effect upon vegetation, unless from time to time there is actual washing

through the soil and removal of the water charged with salt. Without drainage the greater the quantity of water used the greater the eventual damage to the soil, for thereby the subsoil water-table carrying the salts is lifted nearer to the surface. With a properly designed irrigation system the danger of salting ought not to occur; there are, however, many tracts of land where the supply of water is too limited to justify an expensive scheme of irrigation channels with corresponding drainage ditches at a lower level.

Take the case of a farmer with some water from an artesian well at his disposal, with perhaps little rainfall, with land subject to alkali, and no considerable natural fall for drainage. If he merely grades the land and waters it, sterility rapidly sets in; the only possibility appears to be to take a comparatively limited area and to cut out drainage ditches or tile drains 4 or 5 ft. below the surface, even if they have to be led into a merely local hollow that can be abandoned to salt. The bed thus established must then be watered at any cost until there is a flow in the drains, after which the surface is immediately cultivated and the crop sown. There should be no further application of water until the crop covers the land, the use of water must be kept to a minimum, and by the ordinary methods of dry cultivation evaporation must be allowed only through the crop, not merely to save water, but to prevent any rise of salt. With a loose surface and wind-breaks to minimise evaporation it has thus proved possible to grow valuable crops even on dangerously alkaline land. Superphosphate and sulphate of ammonia have proved to be useful fertilisers under these conditions; both tend to prevent the reaction of the soil becoming alkaline, and the calcium salts of the superphosphate minimise the injurious effects of the sodium salts that naturally accumulate in the land. On the other hand, nitrate of soda is a dangerous fertiliser. Attempts have been made to reduce the salts in the land by the growth of certain crops which take up a large proportion of mineral matter, but I have not been able to ascertain that much good can be thus effected. Sugar-beet and mangolds do appreciably reduce the salt content, but are scarcely valuable enough to pay for such special cultivation and the limited irrigation water; the best thing appears to be to grow salt-bush on the non-irrigated margin of such areas, if only to prevent the efflorescent salts from blowing on to the cultivated portion.

Let us now turn to the problem of land reclamation as it occurs in north-western Europe. There are two main types of land that have hitherto been left waste, the peaty and the sandy areas. Of the peaty areas we can distinguish again between the low-lying moors bordering the lower courses of the great rivers; for example, in England near the mouth of the Trent, and the upland peat-bogs of which Ireland furnishes so many examples. They have these features in common—an excess of water, a deficiency of mineral salts, and, particularly in the upland bogs, a strongly acid reaction; but they possess great potential wealth in their richness in nitrogenous organic matter. It is in Germany and Holland that the methods of bringing into cultivation these moors have been most completely worked out; in Germany, for example, it is estimated that there are about five million acres of moorland of which about 10 per cent. are now under cultivation. The reclamation process must begin by drainage, which may be carried out by open ditches, but is most satisfactorily effected by pipes, despite the greater cost. The water-table must be kept some 3 ft. below the surface. In districts which afford a market for peat, as, for example, on the Teufelsmoor near Bremen, the reclamation often begins by cutting out the peat, the lower layer of firm peat being won, dried, and sold for fuel. The upper spongy peat can be used for litter, but some part at least must be thrown back. Where the burning peat is thus extracted the excavation is in places pushed further until the underlying sand is reached, and enough of this is dug to spread over the reclaimed area to a depth of 4 or 5 in. and mixed by cultivation with the spongy peat. Even when the peat is not removed, pits are often made in order to sand the land, so great an improvement does it effect in the character of the crops. However, sanding is not possible everywhere, and there are great areas under cultivation where the reclamation begins with drainage, followed by the cultivation of the immediate surface without either sanding or the removal of the burning peat, which indeed are impossible over large areas, but are carried out by the owners of small farms little by little. Special tools are required: certain forms of disc-ploughs and harrows give the best results; heavy tools for large scale cultivation by steam or electricity are furnished with broad roller-like wheels; even the horses must wear broad wooden shoes.

The next stage is the manuring, and it has only been the development of the artificial fertiliser industry during the last half-century that has rendered the cultivation of this type of land possible. On the alluvial moors where the ground water has always been alkaline, the peat is rich in calcium and no treatment with lime and marl is necessary (the English fens afford an example of this type of soil), but on the true peat-bogs (Hochmoor of Germany) the manuring must begin with a good dressing of burnt lime, or, better, of marl or ground chalk. For meadows and pastures two tons per acre of lime, or twice as much of carbonate of lime, should be applied; the amounts may be halved for arable land. This must be followed by about 5 to 8 cwt. per acre of basic slag and an equal amount of kainit, which applications should be renewed in the second year, but then diminished in accord with the cropping. However, some phosphoric acid and potash salts must be continuously supplied, with occasional dressings of lime or chalk on the acid peaty areas. These latter also require in their earlier years nitrogenous manures, for the peat is slow to yield up the nitrogen it contains. The fertilisers should be nitrate of soda or lime, never sulphate of ammonia. The whole success of the reclamation depends on the use of these manures, as the peat in a state of nature is almost devoid of both phosphoric acid and potash; on the acid peats, again, normal growth is only possible after a neutral reaction has been attained by the use of lime or marl. With this manuring it is found to be easy to establish a good meadow herbage in a very short space of time; it is not even necessary to get rid of the surface vegetation of Erica and other heath and bog plants. The manure is put on and the surface is worked continuously with disc-harrows and rollers, but never deeply; a seed-mixture containing chiefly red, white, and Alsike clovers, *Lotus uliginosus*, rye-grass, Timothy, and cocksfoot, is sown in the spring and soon succeeds the native vegetation.

It is impossible to say what is the cost of the reclamation of moorland in this fashion; the big expense is the drainage and the construction of roads, both of which are entirely determined by local conditions. But of the value of the process when accomplished there can be no doubt. I have seen a case quoted from the *Ostfriesische Zeitung*, where a piece of moor bought for 75*l.* was reclaimed and sold for 900*l.*; and, best test of all, one may see in places like the Teufelsmoor, near Bremen, families living in comfort on thirty to forty acres of what was once merely wild moor with no productive value.

Of even greater interest in England is the reclama-

tion of heath-land, which has of late years been proceeding apace in Germany. In this category we may include all land which owes its infertility to the coarse grade and low water-retaining power of the particles of which the soil is composed, the soil being at the same time as a rule devoid of carbonate of lime, and covered in consequence with heather and similar calcifuge plants. In England there exist extensive tracts of uncultivated land of this character in close proximity to the considerable populations, but the process of reclaiming such land for agriculture seems to have come to an abrupt conclusion somewhere about 1850, when the developing industries of the country began to offer so much greater returns for capital than agriculture. That land of the kind can be cultivated with success is evident from the mere fact that everywhere prosperous farms may be seen bordering the wastes, possessing soils that are essentially identical with those of the wastes. These were brought under cultivation when labour was cheaper, often without calculation of the cost because the work was done piecemeal at times when the men would otherwise have been idle. Were any strict account to be framed, the reclamation probably did not pay its way for many years, and it has only become possible again because of modern advances in science and machinery. As examples of the type of land, I may instance the Bagshot Sands on which, in north Surrey, in Berkshire and Hampshire, and again in its southern development in the New Forest, lie so many thousands of acres of uncultivated heath. No systematic reclamation has taken place, but everywhere farms have been carved out on this formation, often by the industry of squatters, and within reach of London the vast supplies of town manure which used to be available have converted some of it into fertile land. The crystallisation of common rights into charters for public playgrounds, its growing appreciation for residential purposes, will now always stand in the way of the utilisation of most of the Bagshot Sands for agriculture, but further afield there are many areas of similar character.

The Lower Greensand is perhaps equally discounted by its residential value, but on the Tertiaries of Dorset, the Crag and Glacial Sands of Suffolk and Norfolk—the brak, the Bunter Beds of the midlands, lie many expanses of waste that are convertible into farming land, just as Lincoln Heath and much of the beautifully farmed land of Cheshire have been gained for agriculture within the past century. Equally possible is an attack upon the sandy areas, warrens or links, behind the sand-dunes on many parts of the English and especially the Welsh coasts; not all of them are wanted for golf, and many can be fitted for market-gardening. Of old the only way of dealing with such land was merely to clear it, burn the rubbish, and start upon the ordinary routine of cultivation, but for a long time on such a system the crops will scarcely pay their way from year to year, and the permanent deficiencies of the soil in lime and mineral salts remain unrepaired. In Cheshire the enormous value of marl and bones in such a connection was early recognised; it has been the later discovery of the potash salts that renders reclamation a commercial proposition to-day. The method that is now followed is to begin by clearing the land of shrubs, burning off the roughest of the vegetation, and turning over a shallow layer in the summer, leaving the heathery sod to the killing and disintegrating action of sun and frost until the following spring. The manure is then put on—lime or ground chalk or marl as before, basic slag and kainit, and the sod is worked down to a rough seed-bed on which lupins are sown, to be ploughed in when they reach their flowering stage. The growth of the lupins makes the land, they supply humus to bind the sand together and retain moisture, they draw nitrogen from the atmosphere, and with the phosphoric acid and potash form a complete manure for succeeding crops. Sometimes a second crop of lupins is ploughed in, but usually the land is put immediately to an ordinary rotation of rye, oats, potatoes, and clover. When the heath-land is divided among small tenants in an unreclaimed state cropping often begins without the lupins, the necessary nitrogen being imported by nitrate of soda, but for years the land shows inferior results. Only the tenant can rarely afford to lose the year the lupin crop involves, and so great is the demand for land in Germany that the State finds its preferable to let the tenant reclaim than to reclaim for him, and charge him as rent the cost of the more thorough process.

And now as to the finance of the operation: the reclaiming down to the ploughing in of the lupin crop costs from 5*l.* to 6*l.* an acre, the bare heath costs from 5*l.* to 7*l.* an acre, the reclaimed land after a few years' cultivation would sell at 20*l.* to 30*l.* an acre. Meantime the State has probably made a free grant for drainage, looking to get some interest back in increased taxation; the local authority has also made roads for which the increased rating due to a new agricultural community must be the only return. It is a long-sighted policy which will only find its full justification after many years when the loans have all been paid off and the State has gained a well-established addition to its agricultural land and its productive population. In comparing English with German conditions there are certain differences to be taken into account—in the first place the work of reclamation will be dearer in England because of the higher price of labour, then the land will not be so valuable when won because the higher scale of prices for agricultural products enhances the price of land in Germany. Next, I doubt, in view of the great industrial demand for men in England, if we have the men available who will bring to the land the skill and power of drudgery that I saw being put into these German holdings of thirty to forty acres in their earlier years of low productivity. Moreover, in Germany these heaths are generally bordered by forests, in which the smallholder gets occupation for part of the year while his wife and children keep the farm going. For this, if for no other reason, afforestation and land reclamation and settlement should go on together. But, despite these drawbacks, I am still of opinion that the reclamation of such heath-lands is a sound commercial venture in England, either for a landowner who is thinking of a future rather than of a present return on his capital, or for the State or other public body, wherever the waste land can be acquired for less than 5*l.* an acre. The capitalised value of its present rental rarely approaches that figure, but the barrenest heath is apt to develop the potentialities of a gold-mine when purchase by the State comes in question. The map of England is so written over in detail with boundaries and rights and prescriptions that the path of the would-be reclaimer, who must work on a large scale if he is to work cheaply, can only be slow and devious.

There are other possibilities of winning agricultural land even in England, from the slob land and estuaries, from the clays nowadays too heavy for cultivation; but the problems they present are rather those of engineering than of agricultural science. What I should like in conclusion once more to emphasise is, that the reclamation of heath and peat-land of which I have been speaking—reclamation that in the past could only be imperfectly effected at a great and possibly unremunerative expense of human labour—has now become feasible through the applications of science—the knowledge of the functions of fertilisers, the in-

dustrial developments which have given us basic slag and potash salts, the knowledge of the fertility that can be gained by the growth of leguminous plants. From beginning to end the process of reclamation of moor and heath, as we see it in progress in north-western Europe, is stamped as the product of science and investigation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. J. T. Saunders, of Christ's College, has been appointed demonstrator in animal morphology, and Mr. J. Gray, of King's College, has been appointed demonstrator in comparative anatomy. Mr. Saunders has received a commission in the Army, but his post will be kept open for him until the end of the war. Mr. J. R. Menon, intercollegiate student, has been nominated to use the University table at the Zoological Station at Naples.

The following forms part of the address of the Vice-Chancellor of the University, Dr. M. R. James, provost of King's College, on his re-election at the beginning of this month:—

"The remembrance of what has been brilliant or sorrowful in the three terms has paled, for the time at least, before the events of the Long Vacation. The University meets in such circumstances as it has never known. We shall be few in number, and perpetually under the strain of a great anxiety. We may be exposed to actual peril: in any case, we must look forward to straitened resources and, what is more, personal sorrows. Yet there is no doubt that we are bound to carry on our work; for by it we can render definite service to the nation. Our part, while we encourage all of our students who are capable of doing so to serve their country, and while we surrender to that service many valued teachers, is to prepare more men—especially in our medical schools—for rendering active help, and to keep alive that fire of 'education, religion, learning, and research' which will in God's good time outburn the flame of war. Let us devote ourselves to making useful men of the new generation. Let us confine our own controversies within the narrowest limits, and be ready if necessary to postpone them altogether. Let our advanced work—however irrelevant it may seem to the needs of the moment—be unremittingly and faithfully pursued.

"I have spoken of the trials which we are bound to anticipate as a consequence of the war. Let me add that we shall be the better able to bear them, not only because we know that our cause is just, but because we know that the University has contributed a worthy share of its sons to champion that cause. Nearly 2000 applications for commissions from our younger graduates and our undergraduates have passed through the hands of the indefatigable committee of the Board of Military Studies; and this number does not include the very large contingent who have applied through other bodies, those who already held commissions at the outbreak of war, those who have enlisted in the ranks of various branches of the service, or those who are giving their help in tending the sick and wounded without enlisting. It is not at this moment possible to compile accurate lists of all who have responded to the great call. I hope, however, that each college will set itself to secure information as to its own members, with a view to the ultimate publication of the roll of honour of the University.

"It is our plain duty to secure that those who have interrupted their University career for the sake of their country shall suffer the least possible amount of disadvantage thereby. Some measures have already been taken with this object, and others will be necessary.

"I shall have, further, to ask for your co-operation in an effort which is being made to enable some of those Belgian students who in the course of their gallant resistance have been deprived of their whole academic equipment, to continue, in our midst, and with the help of our libraries and teaching apparatus, the life of their universities. This is an object which, I am confident, the Senate will feel honoured in supporting."

The next combined examination for fifty-three entrance scholarships and a large number of exhibitions, at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges, will be held on Tuesday, December 1, and following days. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges. A candidate for a scholarship or exhibition at any of the six colleges must not be more than nineteen years of age on October 1, 1914. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges.

MR. H. PATTERSON, University of Leeds, has been appointed part-time lecturer in physical chemistry at Battersea Polytechnic.

IT is stated in *Science* that the medical school of Western Reserve University receives by the will of Mr. Liberty E. Holden a bequest said to be nearly 200,000*l*. The fund is to be known as the Albert Fairchild Holden Foundation, in memory of Mr. Holden's son.

THE Earl of Rosebery has made a donation of 1200*l*. to the London School of Economics and Political Science for the endowment of a prize to be awarded annually in the department of railway transport at that school of the University of London.

THE Rural Education Conference, which was constituted by the Board of Agriculture and Fisheries and the Board of Education in June, 1910, was appointed for a term of three years. This period having expired, the conference has been reconstituted by the Board of Agriculture and Fisheries under the name of the Agricultural Education Conference. The duty of the conference will be to discuss, and to advise, the Board upon, all questions connected with agricultural education which fall within the province of the Board of Agriculture and Fisheries, and specific questions will, from time to time, be referred by the Board to the conference for consideration. In addition, any member may suggest for discussion questions other than those formally referred to the conference. The Lord Barnard has been appointed chairman of the conference, and Mr. H. L. French (Board of Agriculture and Fisheries, Whitehall Place, S.W.) will act as its secretary.

DETAILED information as to the work of the numerous departments among which the varied activities of the University of Leeds are shared is contained in the calendar for 1914–15. In common with other modern universities, Leeds University includes a faculty of technology, and among its staff are to be found professors of engineering, mining, textile industries, tinctorial chemistry, and dyeing, leather industries, coal gas and fuel industries, and agriculture. Students may graduate in applied science as well as in pure science. The University, which is situated in the heart of a mining district possessing some of the deepest and best equipped of modern English collieries, enjoys the cordial support of the owners and managers of mines, who give the department every facility for

instructing its students. The courses in gas engineering and the technology of fuel meet the requirements of students who are preparing for responsible positions either as gas engineers or in fuel and metallurgical industries. In agriculture the instruction has been arranged to meet the requirements of young men who intend to become farmers, land agents, valuers, or teachers of agricultural science. Other examples could be given of the efforts of the University authorities to provide instruction and guidance for all parts of the community in its area and the support which is being given to the University by all sections of society augurs well for its future usefulness.

FROM Prof. H. S. Carslaw we have received a report, presented to the International Commission, dealing with the teaching of mathematics in Australia, and now published by Angus and Robertson, Sydney, 1914. Up to the present the education in the schools has been mainly influenced by examinations of the "local" type, controlled by the Australian universities. Prof. Carslaw condemns this system, which, of course, tends to lower the educational ideal of the schools to mere examination cramming. A comparison of the syllabuses of these examinations with those now being introduced into the State high schools, and the system of leaving certificates, fully supports what Prof. Carslaw states. The older examinations contain much work that is difficult, useless, and unstimulating, while the new syllabuses are much more practical, interesting, and educationally valuable. Coming next to the universities, we find that the system of combining mathematics and physics in one department still prevails in the newer institutions, and the numbers of students taking mathematics is on the whole distinctly small, having regard of the fact that the subject is compulsory for engineering students. The course in insurance mathematics is a valuable feature of the Melbourne University, and one which we should like to see copied elsewhere and made attractive to candidates for general degrees in arts and science.

THE calendar for the present session of the Armstrong College, Newcastle-upon-Tyne, has been received. The college ranks, together with the "Durham colleges," and the College of Medicine, as one of the three constituent units of the University of Durham. The faculties of science and commerce in the University are seated entirely at Armstrong College, in which alone are held the classes and examinations requisite for bachelor degrees in these faculties. In addition to pure science, the college gives instruction in the various branches of engineering, mining, metallurgy, naval architecture, and agricultural science. The agricultural department directs the Northumberland County Agricultural Experimental Station and the Durham County Station for Dairy Research. For the purpose of forestry instruction the college possesses 900 acres of wood, and its zoological equipment includes a laboratory of marine biology. College diplomas in engineering, naval architecture, mining, mine surveying, agriculture, and commerce, are open to students who are unable to take a complete degree course. A list of the various fellowships for research, scholarships, and exhibitions, of which there is a large number, is given in the calendar. We notice that a fellowship of the value of 125*l.*, and two research studentships of the value of 62*l.* 10*s.* each, are offered for competition in June of each year. The holders must engage in advanced study or research to the satisfaction of the council and be graduates of the University of Durham.

A COPY of the calendar for 1914–15 of the Manchester Municipal School of Technology has been received. It is arranged in two parts, one dealing with university courses and the other with part-time courses. The school offers systematic training in the principles of science and art as applied to mechanical, electrical, municipal, and sanitary engineering; architecture and the building trades; the chemical industries; the textile industries; and photography and the printing crafts. Its work includes advanced study and research; university courses in the faculty of technology in the Victoria University of Manchester, of which the school is an important constituent; part-time day courses for engineers' and other apprentices whose employers allow them to devote one whole day a week to study; part-time evening courses, involving attendance on three evenings a week for five years; and other part-time classes for advanced study and research, or in preparation for the external degrees of the University of London, or for other purposes. Students who, having passed the matriculation examination or its equivalent, satisfactorily complete a three years' university course in accordance with the regulations, become entitled to the degree of Bachelor of Technical Science. A fourth year's course of advanced study and research prepares such graduates for the higher degree of Master of Technical Science. These degrees give the holders exemption from further examination when desirous of entering certain professions and learned societies, which are enumerated in the calendar. Very full particulars of the equipment, the various courses, and the general arrangements of the school are given in a manner which makes very simple reference by the intending student.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 14.—M. P. Appell in the chair.—A. **Lacroix**: The recent eruption of Ambrym (December, 1913) and the constitution of the lava from this volcano. The lava is of the angitic labradorite type, too poor in olivine to be considered a true basalt. A complete chemical analysis is given.—Kr. **Birkeland** and M. **Skolem**: Calculations of the lines of equal intensity in the zodiacal light.—B. **Jekhowsky**: The eclipse of the sun of August 20–21, 1914. Particulars of observations taken at the Observatory of Montsouris.—Ch. **Vaillant**: The replacement of photographic plates by gelatino-bromide paper in radiography. By the use of a reinforcing screen with exposures of from 4 to 30 seconds good negatives were obtained. The cost is about one-thirtieth of the ordinary plates.—Julien **Loisel**: The monographic representation of the mean direction of the wind.

September 21.—The President announced the death of M. Pérez, correspondant for the section of anatomy.—Maurice **Hamy**: Remarks relating to the construction of an equatorial *coudé*.—Marin **Molliard**: Chemical modifications of plant organs undergoing a true fermentation.

CALCUTTA.

Asiatic Society of Bengal, September 2.—W. **Ivanow**: The language of the gypsies of Qāināt (in eastern Persia). The gypsies of eastern Persia are a wandering tribe who live exclusively in tents and present signs of their Aryan origin, with Shemitic, Turkish, and even Dravidian admixtures. They seem to be allied to the Jats, the well-known Kshattriya tribe of India, to the Da-Yueti tribe to which Kaniska belongs, and to other kindred tribes. They dress like Persian peasants, and their religion is Islam of the Shia Sect. Their language has lost its original purity and is now about the same as Persian spoken in Qāināt. There are still some genuine gypsy words which are used to

conceal their secrets, but words indicative of abstract ideas are wanting altogether. The paper also deals with many important features of the genuine gypsy language from the points of view of phonetics, morphology, vocabulary, etc.

BOOKS RECEIVED.

The Canterbury College, Christchurch, New Zealand. 41st Annual Report. June. Pp. 47. (Christchurch, N.Z.: Canterbury College.)

Koninklijk nederlandsch Meteorologisch Instituut. No. 106. Ergebnisse Aerologischer Beobachtungen i. 1909–12. Pp vi+146. (Utrecht: Keminck and Zoon.)

Regenwaarnemingen in Nederlandsch-Indie. Deel ii. Uitkomsten. Pp. 170. (Batavia.)

Life: Its Origin and Energy Mechanism. By Jadroo. Pp. 32. (London: H. Kimpton.) 1s. net.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, Dominica, 1913–14. Pp. 49. (Barbados Imperial Commissioner of Agriculture.) 6d.

University of Durham. Armstrong College, Newcastle-upon-Tyne. Calendar, Session 1914–15. Pp. 534. (London and Newcastle: A. Reid and Co., Ltd.) 1s.

Specimens of Languages from Southern Nigeria. By N. W. Thomas. Pp. 143. (London: Harrison and Sons.) 4s. net.

The World of Life. By Dr. A. R. Wallace. New and cheaper edition. Pp. xvi+408. (London: Chapman and Hall, Ltd.) 6s. net.

Examples in Arithmetic, Extracted from the Public School Arithmetic. By W. M. Baker and A. A. Bourne. Pp. xii+217+lii. (London: G. Bell and Sons, Ltd.) 2s.

Modern Instruments and Methods of Calculation. Edited by E. M. Horsburgh. Pp. vii+343. (London: G. Bell and Sons, Ltd.; Edinburgh: Royal Society of Edinburgh.) 6s. net.

Transactions of the Royal Society of Edinburgh. Vol. xlix., part iii. Session 1912–13. Pp. 531–829. Vol. xlix., part iv. Session 1913–14. Pp. 830. Vol. l., part i. Session 1913–14. Pp. 251. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 30s., 21s. 9d., 25s. 9d. respectively.

The National Physical Laboratory. Report for the Year 1913–14. Pp. 144. (Teddington: W. F. Parrott.)

The National Physical Laboratory. Collected Researches. Vol. xi., 1914. Pp. iv+320. (London: Harrison and Sons.) 20s.

Department of the Interior. Weather Bureau. Annual Report of the Weather Bureau for the Year 1911. Part iii., Meteorological Observations Made at the Secondary Stations during the Calendar Year 1911. Pp. 266. (Manila: Bureau of Printing.)

Board of Agriculture and Fisheries. Annual Report of the Horticultural Branch. Proceedings under the Destructive Insects and Pests Acts, 1877 and 1907, and the Board of Agriculture Act, 1889 (Section 2, Sub-Section 3) for the Year 1913–14. Pp. vii+79. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4½d.

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DIARY OF SOCIETIES.

MONDAY, OCTOBER 12.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates), at 8.—The Reclamation of Waste Products in Industrial Undertakings: G. H. Ayres.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Cotton Spinning: W. Scott Taggart.

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INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Report of the Refrigeration Research Committee: Sir J. Alfred Ewing.

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